National University «Yuri Kondratyuk Poltava Polytechnic»

Educational and Scientific Institute of Architecture,

Construction and Land Management

Department of Construction and Civil Engineering

Explanatory Note

to the Master's qualifying work

topic: **Project for a separate shelter for 600 people in the city of Lanzhou**

Completed: 6th year student, group 601BP

specialty 192 «Construction and Civil Engineering»

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Chapter 1: Compilation Principles and Basis

1.1 Compilation Principles The compilation shall comply with all applicable laws, regulations, mandatory provisions, and rules and regulations issued by the state, the construction industry, and local governments.

Meet the owner and design institute's drawing requirements.

1.2 The preparation is based on relevant national and local regulations, as detailed below:

Table 1.1 Relevant Specifications

序号	规范名称	编号
1	Unified Standard for Construction Quality Acceptance of Building Engineering	GB 50300-2018
2	Code for Acceptance of Construction Quality of Building Foundation Engineering	GB 50202-2018
3	Code for Acceptance of Construction Quality of Masonry Works	GB 50203-2019
4	Code for Acceptance of Construction Quality of Concrete Structures	GB 50204-2015
5	Code for Acceptance of Roofing Engineering	GB 50207-2012
6	Code for Acceptance of Construction Quality of Building Floor Engineering	GB 50209-2013
7	Code for Acceptance of Construction Decoration and Renovation Quality	GB 50210-2018
8	Code for Construction Project Management	GB/T 50326-2017
9	Construction Specification for Residential Decoration and Renovation	GB 50327-2017
10	code of engineering survey	GB 50026-2019
11	Technical Specification for Waterproofing of Underground Engineering	GB50108-2008
12	Environmental Noise Emission Standard for Construction Site Boundary	GB12523-2011
13	Code for Acceptance of Construction Quality of Building Energy Efficiency Projects	GB50411-2019
14	Code for Construction Organization Design	GB/T50502-2009

Chapter 2 Project Overview

2.1 Architectural Design Overview Building

Project for a separate shelter for 600 people in the city of Lanzhou of 7,361.2 square meters, constructed with a shear wall structure, including one basement level and eighteen above-ground floors.

The exterior finishes of this project feature white exterior walls with aluminum alloy windows. Interior finishes include mixed mortar plastering and latex paint for all spaces except bathrooms, which are finished with ceramic tiles. The roof is insulated with expanded perlite and waterproofed with membrane materials, while bathrooms use polyurethane membrane waterproofing. Outdoor steps are constructed with marble.

Table 2.1 Building Information Table

engineering order	two stage	Building Classification	[计] public works
designed service life ：	50 years	overall floorage	7361.2
building height, height of building	52.2m	Building area (㎡):	338.04
number of plies	1 basement level, 18 above-ground floors	fire resistance rating	two stag
Roof waterproofing grade:	one-level		

2.2 Overview of Structural Design

Table 2.2 Structural Information Table

site category, site classification	Class II	base form	raft foundation
[计] structure type	shear wall	seismic	7 degrees

	structure	fortification intensity
lightning protection rating	Class II	

Chapter 3 Construction Deployment

3.1 Project Objectives

Quality Objective: Ensure passing the acceptance inspection in one go.

Project Duration Objective: 410 calendar days.

Safety Objective: "Five Nones" for major accidents (no deaths, no serious injuries, no collapses, no poisoning, no fires), and the frequency of minor injuries is 3‰.

Environmental Management Objective: No disturbance to residents and zero complaints.

3.2 Selection of Construction Plan

In view of the structural form of this project, the construction plan mainly elaborates on the specific measures for the concrete structure part.

3.2.1 Construction Arrangement

After entering the site of this project, the construction will start from the north side, and the earth excavation will proceed from north to south.

3.2.2 Selection of Main Plans

(1) Formwork Engineering

Clay bricks are used for the side forms of ground beams and bearing platforms; For concrete formworks of other parts except bearing platforms, 18mm thick wooden nine-ply boards are used, and 50×100 wooden squares are used for reinforcement; Tie rods and steel pipe scaffolding tubes. When reinforcing waterproof concrete, tie rods with water-stop steel plates shall be used.

(2) Reinforcement Engineering

Mechanical processing is adopted for steel bar processing; Manual binding is used for steel bar binding; Tower cranes are used for vertical transportation of steel bars.

(3) Concrete Engineering

Commercial concrete is used for this project; Concrete pumps are used for vertical and horizontal transportation of concrete.

(4) Vertical Transportation

During the construction stage of the main structure, tower cranes are used for vertical transportation of materials, with manual auxiliary transportation; During the decoration stage, construction elevators and high-speed derricks are used for vertical transportation of materials.

(5) External Scaffolding Engineering

All construction materials for external scaffolding are erected with steel pipes and connected with fasteners. The construction technology of external scaffolding adopts double-row steel pipe fastener cantilever scaffolding. The external scaffolding is fully enclosed with dense mesh safety nets.

(6) External Scaffolding Engineering

The external scaffolding of this project adopts I-steel cantilever double-row fastener-type steel pipe scaffolding, which is erected upwards synchronously with the structure. It will continue to be used during decoration.

(7) Masonry and Decoration Engineering Plan

Aerated concrete blocks are used for masonry, which will be inserted after the construction of structural floors is completed. Plastering and floor engineering will be inserted in sequence after the previous process is ready. Mortar is centrally mixed, transported to the site by motor dumpers, and construction elevators are used for vertical transportation.

3.3 Overall Construction Sequence

According to the characteristics of the project, the site conditions, technical strength and the machinery and equipment, the project will adopt the construction scheme of "comprehensive development, civil engineering as the main line, installation engineering followed by, flowing operation, interlaced, tight connection, tight organization, full space, continuous time, using information construction".

3.4 Construction Organization Structure

3.4.1 Establishment of Construction Organization

This project strictly implements the "Project Management Method" for construction, with a newly established project management team composed of outstanding project managers responsible for specific construction management. We hereby commit to the owner that all selected project teams will work with valid certifications and strictly adhere to certification requirements, and that the project management team will be solely accountable for this project. The project manager system is implemented, under which the project manager will be fully responsible for quality, schedule, safety, cost, and civilized construction. All construction management departments will operate under the direct guidance of the project management team to systematically organize construction, ensuring that quality, schedule, and safety meet the required objectives.

3.4.2 Responsibilities of the Construction Organization Department

Table 3.1 Departmental Responsibilities

post	Department Responsibilities
project manager	Responsible for the daily affairs of the whole project general contracting. Coordinate the formation of the project organization and staff allocation, establish rules and regulations, clarify the responsibilities of relevant personnel in the project department and subcontractors, and lead the project department in carrying out its work. Lead the formulation of the project general contracting management plan and implement the objectives and policies of project management. Responsible for formulating the project budget, fund utilization plan, progress payment, and final settlement. The main contents of the project management decision-making include personnel appointment decision, major technical scheme decision, financial work decision,

	resource allocation decision, construction period decision and change decision. Approve the major construction and management plans of each subcontractor, and supervise and coordinate their implementation. Maintain regular communication with the owner and the supervisor to resolve any issues that may arise, assist them in addressing concerns, and safeguard the owner's interests.
Technical Lead	Under the leadership of the project manager, the establishment of the project's technical and quality management assurance system is specifically overseen, with technical and quality responsibilities allocated and the accountability system for technical and quality performance implemented. Review the construction organization and construction plans of each subcontractor, and coordinate technical and quality issues among them. Maintain regular communication with the design and supervision teams to ensure their requirements and instructions are fully implemented across all subcontractors. Organize technical experts to tackle key technical challenges of this project, conduct research on new processes and technologies, and ensure the smooth progress of the project.
line executive	Comprehensively organize and manage the production activities of the construction site, and rationally allocate labor resources. Responsible for making the production organization, production management and production activities of the project conform to the implementation requirements of the construction plan. The project schedule management is the key to ensure the construction on schedule. Responsible for the project's safety production activities and the management of its safety management organization system. Coordinate the progress conflicts between subcontractors and work teams, and the conflicts between the work fronts, so that the construction of each subcontractor can be carried out in an orderly and reasonable manner. Implement standardized management at the construction site to ensure it earns the municipal title of model civilized construction site. Ensure on-site management personnel implement environmental protection measures and guarantee the enforcement of environmental protection policies. Responsible for engineering budgeting, final accounting, and payment settlement;
Installation Manager	fully responsible for the progress, safety, and civilized construction of the project's mechanical and electrical installation production; Focus on coordinating the installation of key projects and construction across all regions. All installation specialties, regional production safety, and construction civilization of the project; Ensure the installation project meets the overall schedule requirements.
Ministry of Technology	Under the leadership of the Chief Engineer, I am responsible for the daily technical management of engineering projects, coordinating with the Bureau's Science and Technology Department to provide technical support and services to the project management team.

	Study the key technical problems in construction, review the construction organization design, important technical scheme and important technical treatment scheme on site, solve the important technical problems in construction in time. Specifically, research on major technical issues in construction projects is conducted, and the application of new technologies, equipment, materials, and processes is organized and promoted. Responsible for inspecting and supervising project quality, and coordinating the handling of major quality incidents. Responsible for the owner, design institute, supervision and other units to form a good coordination on the technical matters.
Contract Department	Responsible for daily contract management of engineering projects, coordinating with the company's Contract and Business Department to provide contract support and services for the project management team. Responsible for formulating the project fund utilization plan, managing project costs, and analyzing economic activities. Responsible for reviewing and supervising material and labor cost settlements. Responsible for reviewing and consolidating the monthly budget and settlement reports of the project management team, and submitting them to the company headquarters. Responsible for supervising and inspecting the use of special funds for work safety to ensure their dedicated application;
Quality and Safety Department	Under the production manager's leadership, I oversee daily quality management for engineering projects, coordinate with the company's Quality and Safety Department, and provide support and services to the project management team. In accordance with the contract and the company's quality and safety documents, the quality and safety objectives are broken down and assigned to responsible departments and individuals. Meanwhile, quality and safety control, inspection, and supervision are implemented throughout the entire project process to ensure the achievement of the contract's quality and safety objectives. Lead the phased review of quality and safety objectives, coordinate with government regulatory authorities for inspections and oversight, actively solicit feedback and suggestions, and report to the company headquarters. Responsible for inspecting sub-projects, sub-items, and final products, and participating in the quality evaluation of final products, with independent authority to exercise quality supervision during construction.
Construction Department	Under the leadership of the production manager, I am responsible for the daily production organization and management of engineering projects, providing support and services for the production organization of the project management department. Comprehensively organize the production activities of the construction site and rationally allocate the labor resources. The primary responsibility involves overseeing project progress management, developing milestone schedules, and ensuring their implementation. Special attention is given to monitoring the completion of critical milestones to guarantee the project timeline objectives are met.

	Overall coordinate the progress conflict between subcontractor and operation team and the field operation surface conflict, make the field construction between subcontractor orderly and reasonable.
Materials Department	Under the leadership of the production manager, I am responsible for the procurement management of bulk materials and machinery for engineering projects, coordinating with the company's materials department to provide support and services to the project management team. Be fully responsible for the procurement of bulk materials and machinery for the entire project, ensuring timely delivery to meet the construction schedule. Participate in the consultation and bidding for materials and machinery provided by Party A, and coordinate the supply management of these materials and machinery.
Power Department	Under the production manager's leadership, I oversee the operation and maintenance of on-site machinery, coordinate with the company's power department, and provide support and services to the project management team. Be fully responsible for the maintenance of all construction machinery and equipment, ensuring their optimal condition to meet the project's schedule requirements. Be fully responsible for the construction power supply on site.

3.4.3 Measures to Ensure the Efficient Operation of the Construction Organization

Organize a strong project team by selecting managers who are ideologically sound, professionally competent, capable, cooperative, and service-oriented.

Establish and improve the responsibility system for project managers, foremen, office staff, materials, machinery, and labor relations, with the engineering leadership team conducting regular evaluations of each specialty.

Strengthen the incentive and restraint mechanism, formulate performance evaluation methods, and organize regular meetings for project management team members to inspect work quality.

Chapter 4 Construction Plan

4.1 Construction Preparation

Construction preparation serves as a critical foundation for engineering projects and constitutes a vital phase in the construction process. This preparatory work involves creating optimal conditions and ensuring project objectives are achieved through comprehensive planning in technical, organizational, and resource allocation (human, material, and financial). It must be thoroughly considered based on the project's characteristics, construction conditions, and contractual requirements to guarantee smooth commencement and execution of construction activities.

Prior to project commencement, the technical director of the Civil Engineering Department shall organize relevant technical personnel to thoroughly review the drawings. They shall participate in design briefings, drawing reviews, axis pile handovers, temporary water and electricity handovers, and site surveys organized by the construction entity. Temporary facilities shall be arranged on-site based on actual conditions and the construction entity's unified requirements. The technical department shall prepare an implementable construction organization design and sub-item construction plans, providing technical briefings and pre-job training to foremen and specialized teams. Concurrently, material, equipment, and personnel entry plans shall be formulated in accordance with the overall construction schedule.

The construction preparation work plan is detailed in Table 4.1.

Table 4.1: Summary of Construction Preparation Work for This Project

order number	job content		operational staff
1	Drawing study, review, technical briefing, and preparation of construction organization design		Engineer, Technician
2	construction budget of foundation, main body and decoration		budgeteer
3	Perform construction layout based on the transferred reference point		gauger
4	Drawing review and material planning		Construction workers from various specialties
5	Temporary construction set up	Reinforcement bar workshop, cement warehouse, laboratory	Construction workers from various specialties
		Power distribution room, carpentry workshop	Construction worker, electrician supervisor
		Living and office space	Construction workers from various specialties
		Roads and Greenery	Construction workers from various specialties
6	power supply for construction	Power capacity increase outside the construction site	expert engineer
		Power supply within the construction site	Electrical Team Leader
7	construction water supply pipe laying		Construction worker, hydraulic engineer supervisor
8	Woodworking machinery and steel bar processing machinery installation		Construction worker, machinery team leader
9	tower crane install	concrete foundation construction	Professional Construction Worker
		Tower crane installation and acceptance	Captain of the Machinery Team
10	Installation of concrete mixer and mortar mixer		Captain of the Machinery Team
11	On-site education for employees		Head of Quality and Safety Department, Chief Engineer of the Project, and All Project Managers
12	Submit the work report		project manager

4.2 Earthwork Excavation Plan

The key points are the entry and exit route of the earthmoving machinery, the location of the ramp, the depth of the layered excavation and the sequence of the section excavation, the drainage of the foundation pit, the earthwork stacking and transportation, etc.

When excavating soil mechanically, the slope surface should be leveled as much as possible, followed by manual trimming to remove loose soil. The allowable deviation for slope surface flatness is ±100mm.

Prior to foundation pit excavation, proper drainage of the surrounding ground must be implemented, and the pit top perimeter should be leveled to prevent rainwater and other surface water from seeping into the soil.

The foundation cushion should be constructed as soon as possible after the pit is excavated to the designed elevation to reduce the exposure time.

4.3 Engineering Survey Plan

4.3.1 Main Measurement Work

Table 4.2 Main Measurement Sheets

order number	
1	Establishment and Re-measurement of the Control Network of the First Survey
2	The Layout of the "External Control Method" for the Second Class Control Network of Plane and Elevation
3	Vertical Surveying of the Second Grade Control Network of Plane and Elevation by Internal Control Method and Synchronous Control Tower Axis and Elevation
4	Three-level control network surveying for plan and elevation, including the axis and elevation of control columns, beams, shear walls, doors, and openings
5	Management and coordination of surveying for Party A's specialized subcontracting, including curtain wall, mechanical and electrical installation, and interior finishing works.
6	Measurement of Position Correction of Three-dimensional Coordinate and Analysis of the Influence of Climate Condition on the Measurement Results

7	Component Installation Measuring and Control Absolute Elevation to Ensure Vertical Component Cumulative Error Controlled
8	Monitoring of settlement during construction

4.3.2 Measurement Personnel and Instrumentation

Table 4.3 Measurement Personnel Table

post	personnel	Tasks and Job Responsibilities
Measurement Leader	1 person	Responsible for measurement planning and professional technical construction management
Measurement Engineer	1 person	program preparation, theoretical analysis, layout and transfer of measurement control network, floor measurement operation, technical data preparation, office calculation

The surveying tasks primarily involve measuring and marking the main axis line, transferring elevation data, layout of sub-projects, settlement monitoring, foundation pit displacement observation, and environmental monitoring. All instruments are sent to specialized institutions for calibration to ensure their accuracy meets the required standards. The proposed instruments and equipment are as follows:

Table 4.4 Instrument Configuration Table

order number	name	model	quantity	remarks
1	Topcon total station	GTS-100N	1	Control measurement, 3D coordinate correction
2	JZC-G Laser Automatic Leveling and Vertical Alignment Instrument (Celestial Level)	JZC-G	1	coordinate surveying verticality monitoring
3	theodolite	J2	1	Axis calibration, perpendicularity measurement
4	level	N3	1	level measurement
5	walkie-talkie	Key One	6	2km
6	Sopwith staff	5m	4	level measurement
7	tape	5m	5	surveying and layout
8	Large scale	Tashima brand 50m	3	surveying and layout

4.3.3 Layout and Construction Process of Survey Control Network

Transfer and protect the engineering plane control points and elevation control points with the owner or surveying institute. Verify the transferred measurement control points, and conduct joint surveying when the accuracy meets the requirements. Monthly verification of the established measurement control network is required.

Table 4.5 Survey Control Network Table

order number	control network	Key Points of Control Network Setting
1	master control network	The red line stakes or urban plane control points and elevation control points are set up by the owner or the surveying institute in the construction site and its vicinity.
2	secondary control network	According to the primary control network, the secondary control network is established around the perimeter of the wall, which mainly includes the plane control network and the elevation control network.
3	three level control network	The three level control network is established in the building according to the secondary measurement control network, and the three level control network "internal control method" is used to control the building plane positioning.

4.3.4 Quality Assurance Measures for Measurement

The measurement process strictly adheres to the relevant provisions of engineering surveying standards, with a verification system in place to ensure every point is double-checked. No subsequent measurements are conducted unless the preceding step has passed verification.

All measuring instruments must be sent to specialized institutions for inspection and calibration, and can only be used within their valid period. Prior to measurement, necessary inspections must be conducted on the

instruments involved, such as total stations, zenithometers, levels, tower rulers, and steel tape measures. Only after passing these inspections can the instruments be put into use for measurement operations.

All control point measurements must be documented in writing. All survey data used during construction should be calculated and submitted to the survey supervisor for review. Only after certification by the supervising engineer can the data be put into use and archived.

The positioning pile is fixed by pouring concrete around it, a protective frame is erected, and clear signs are hung for guidance. The leveling reference points and structural positioning lines should be extended as far as possible to permanent structures, with clear markings. Materials must not be piled up to obstruct the view.

Before each layout and elevation measurement, the results must be verified against control points to ensure accuracy before proceeding with detailed layout and elevation work. When setting up survey points, instruments should be placed on concrete structures whenever possible to prevent temporary facilities from deforming and misleading measurements or compromising accuracy.

The survey control network at all levels should be re-surveyed regularly to maintain the survey results of the control network at all levels.

4.4 Reinforcement Works

4.4.1. Reinforcement Joint

Column reinforcement bars: Grade III steel with diameter of 16mm or larger shall be connected by electroslag pressure welding.

Horizontal beam reinforcement bars: Grade III steel with diameter ≥Φ 22 shall be connected by straight-threaded joints, while those below Φ22 shall use welded joints.

4.4.2 Joint Requirements

The welded joint must have straight and aligned steel bar ends. Before welding, thoroughly remove rust and oil from the 3.5×15 mm area around the ends to prevent burn damage caused by poor contact.

4.4.3 Overlap Joint Requirements

The binding joints of all tension bars shall be staggered. Within a 1.3 times the lap length L range from the center of any binding joint, the percentage of the total cross-sectional area of tension bars occupied by the cross-sectional area of the bars at the binding joint shall comply with the following provisions:

The tensile zone shall not exceed 25%;

The compression area should not exceed 50%.

The transverse spacing of reinforcement bars in the binding joint shall not be less than the bar diameter and shall not be less than 25mm.

Within the bound joint section, the cross-sectional area of the load-bearing reinforcement shall not exceed 50% of the total cross-sectional area of the load-bearing reinforcement.

For secondary steel below F20, if non-welded lap joints are used, the lap length La

The following requirements must be met, with a minimum of 300mm.

4.4.4 Column Reinforcement Construction

For vertical reinforcement bars in columns, electroslag pressure welding joints shall be used for bars with diameters ≥22mm, while tie joints shall be employed for bars <22mm. These joints must avoid the highest stress zones, specifically within a 600mm range above and below the core zone. In the jointed sections, the positions of the joints shall be staggered by 35d. As per design specifications, stirrups shall be densely arranged within designated ranges above and below column joints. After completing the binding of column wall stiffeners, horizontal positioning stirrups shall be welded to ensure correct positioning and prevent reinforcement bar displacement.

The column reinforcement bars should be pre-installed with joints approximately 1000mm above the foundation slab's top surface. When leaving the ends, ensure the joints are offset by 50%. After the slab concrete is poured, the bars can be connected upward.

The protective layer of column reinforcement bars is controlled by prefabricated cement mortar blocks, with specifications of 50×50×protective

layer thickness. When manufacturing the blocks, embedded wire is used for binding. The spacing between blocks is 1000mm.

4.4.5 Roof Beam and Plate Reinforcement Construction

For steel bars with diameters ≥20mm, straight-threaded connections are used; for those <20mm, welding or binding connections are employed.

During beam reinforcement binding, primary and secondary beams are reinforced simultaneously. At intersections between slabs, secondary beams, and primary beams, slab reinforcement is positioned above, secondary beam reinforcement is centered, and primary beam reinforcement is below. For double-layer reinforced beams, 25mm diameter short rebars are directly placed between the two layers to ensure precise spacing. At stirrup hook overlap points, reinforcement bars should be staggered and bound to different support force bars within the beam.

The reinforcement binding sequence for beams and slabs is: primary beam reinforcement → secondary beam reinforcement → slab primary reinforcement → slab secondary reinforcement. During reinforcement binding, attention should be paid to the beam elevation, axis alignment, cross-sectional dimensions, and specifications/quantity of reinforcement. When secondary beams intersect with primary beams, the secondary reinforcement should be positioned above the primary reinforcement.

All steel bars shall be connected by binding. Before laying the steel bars, first mark the spacing between main bars and distribution bars on the

formwork, then arrange the load-bearing bars according to the marked spacing before placing the distribution bars. For one-way slabs, except for the intersection points of the three outermost bars on both sides, the middle points may be bound alternately. All intersection points of the bars in two-way slabs must be bound. Negative moment bars on the slab shall be placed as required and ensure correct positioning.

The concrete cover blocks for beam and slab reinforcement are prefabricated with cement mortar, measuring 50×50× cover thickness. Beam reinforcement blocks are staggered at 800mm intervals, installed at the bottom and both sides of the beam. Slab reinforcement blocks are placed at $1m^2$ intervals, positioned beneath the main reinforcement and securely tied. Small support blocks are installed between upper and lower slab reinforcement layers at 1000mm intervals, tied to the reinforcement of both layers to form a continuous structure. At negative moment reinforcement areas, the blocks are spaced closer and positioned nearer to the support. During concrete pouring, a dedicated worker is assigned to monitor and correct any reinforcement deviations.

Reinforcement binding shall be performed in accordance with construction drawings and specifications. All embedded bars in columns and walls must not only meet the anchorage length requirements but also be securely tied to the lower reinforcement bars. When necessary, additional horizontal bars may be welded in place, provided that they do not damage the

main reinforcement bars. Wall horizontal bars must not only satisfy the anchorage length requirements but also hook onto the vertical bars of their concealed columns.

When extending the vertical reinforcement bars of columns, to prevent excessive free suspension, wooden positioning cards or steel pipe scaffolding can be used for fixation to ensure precise positioning of the reinforcement bars.

After the binding of the steel bars is completed, it is prohibited to step on them arbitrarily. A bamboo plank should be laid to pave the passage for walking.

During construction, any replacement of steel bars must be approved by the design institute and the owner before implementation.

When binding steel bars, it is strictly prohibited to let them touch the formwork to prevent water leakage.

After the self-inspection of the completed steel bar binding, the concealed works must undergo acceptance inspection by the quality supervision station, the supervision company, the owner, and other relevant parties. Only after the inspection records are properly documented can the concrete pouring proceed.

4.5 Formwork Engineering

The formwork for beams, slabs, and columns in this project primarily uses 18mm thick double-sided plastic-coated nine-layer plywood, with

dimensions of 1830×920×18mm. The foundation exterior formwork employs brick core, while two sets of vertical structure formwork and two sets of beam-slab formwork are provided.

4.5.1 Foundation Formwork

Brick formwork construction shall be applied to foundation beams and piers. The specific construction methods are as follows: For structures with heights ≤0.6 meters, MU10 clay solid bricks (120mm thick) shall be used with M7.5 cement mortar; for heights between 0.6 and 1.2 meters, MU10 clay solid bricks (240mm thick) shall be used with M7.5 cement mortar; for heights exceeding 1.2 meters but ≤2.2 meters, MU10 clay solid bricks (370mm thick) shall be used with M7.5 cement mortar; for heights exceeding 2.2 meters, MU10 clay solid bricks (490mm thick) shall be used with M7.5 cement mortar. The formwork surface shall be plastered with 20mm thick 1:2.5 cement mortar.

When constructing brick-faced masonry, a 20mm plaster layer must be left along the bearing platform's edge to ensure precise clearance dimensions after plastering. The brick surface should be coated with 1:2 cement mortar and smoothed. After waterproofing, apply a 20mm protective layer of 1:2 cement mortar on the waterproofed surface. This waterproof layer must bond seamlessly with the base layer's waterproofing system to form a complete waterproofing system.

4.5.2 Column

Column formwork is self-secured using vertical timber beams (stirrup spacing=500) and horizontal stirrup spacing48 steel pipes (with spacing matching the bolt spacing). Φ12 bolts are inserted into Φ20 rigid plastic pipes to create tension with horizontal steel pipes for cross-section control. Bolt spacing starts at stirrup spacing=250, with horizontal spacing of stirrup spacing=400 for distances below 2.4 meters and stirrup spacing=600 for distances above 2.4 meters. Embedded Φ20stirrup spacing500 steel bar positioning piles are installed on upper floors to ensure alignment and prevent displacement during concrete pouring at column bases. Column-wall formwork is secured using a combination of top braces and support systems. To prevent formwork expansion at column-wall junctions between upper and lower floors, the upper formwork should be lowered by at least 300mm below the lower floor level and supported on timber beams mounted on embedded bolts at lower column tops. For columns on the first floor, plywood is used with self-secured vertical timber beams and horizontal steel pipes, controlled by Φ 12 tension bolts (vertical stirrup spacing=400). Before column formwork installation, 100mm-wide 18mm-thick plywood strips are nailed onto concrete floors to mark column positions, ensuring precise formwork alignment and reinforcing base fixation.

4.5.3 Beam and Slab Formwork

The nine splints were used, and the self-fixation was made of wooden beams and steel pipe back braces.

Beam formwork installation: Align the axis, beam position, and horizontal line on the column.

Bottom beam formwork installation: Adjust the support elevation according to design specifications, then install the bottom beam formwork and level it with stringing. For beams with a span of 4 meters or more, the mid-span bottom beam must be arched as per design requirements. If no specific design requirement exists, the arch height should be 0.1% to 0.3% of the beam span. At the junction of primary and secondary beams, the primary beam should be arched first, followed by the secondary beam. All cantilevered beams must have a 0.6% arch at their cantilever ends.

Install beam side formwork, including support boards and diagonal braces, along the ink line. To prevent expansion at the base of the formwork, install beam clamps at the bottom. The height of the beam side formwork should be determined based on the beam height and the proximity to the floor slab formwork.

For the curved lines in the structure, a construction method of first forming the mold and then installing and reinforcing can be adopted. The mold-forming method involves dividing the curved line into several small segments, each segment being assembled into the designed shape using

narrow-width planks. A layer of galvanized iron sheet is then nailed onto the surface of the mold. The prepared small segments of the mold are transported to the site and assembled together, subsequently combined with other molds for reinforcement.

4.5.4 Floor Formwork

Install the supporting columns and main joists according to the formwork layout diagram. The spacing between columns and joists should be determined during formwork design based on the concrete weight of the floor slab and the construction load. Typically, the columns are spaced 800–1200mm apart, the main joists 600–1200mm apart, and the smaller joists 400–600mm apart. The column arrangement should allow for construction access routes.

Adjust the height of the support column, level the main keel, and install the secondary keel.

The formwork can be extended outward and closed inward at the center. When pressing the side, the corner formwork should be aligned and nailed in place.

After floor formwork installation, verify the support system's stability and ensure the beam and slab surfaces are thoroughly cleaned.

4.5.5 Beam and Slab Formwork Support System

The support system employs Φ48 steel pipe scaffolding, with upright

poles spaced ≤800 mm for floor-level beams and ≤1000 mm for floor slabs.

4.5.6 Column Formwork

Based on the project's characteristics, the column formwork utilizes plywood, 80×80 timber blocks, and steel pipe back braces. For columns wider than 700R, φ12 wall-piercing bolts are installed at 700mm intervals, with DN20 PVC pipes internally routed to control the cross-sectional area.

4.5.7 Formwork Removal

Column formwork removal must preserve structural edges and surfaces. As per the reserved test block pressure test report, external cantilever fasteners shall be removed when concrete strength reaches 100%. The lower temporary supports may be removed only after the upper cantilever components are removed and no construction loads remain. For other cast-in-place concrete beams and slabs (span ≤8m), formwork removal is permitted only after concrete strength reaches 75%.

4.6 Concrete Works

4.6.1 Overview

This project uses commercial concrete, and the concrete pouring is carried out by a HBT60 concrete pump.

4.6.2 Construction Preparation

(1) Signing of Ready-Mixed Concrete Supply Contract

The concrete mixing station selection focuses on the supply capacity of the mixing station, the operation of the machinery and equipment, the transportation capacity, the quality of the concrete raw materials, the level of concrete testing, the concrete supply distance, the technical indicators after the mixing, the unit price and many other factors.

Various technologies, quality assurance

The concrete supply contract must specify the following technical and quality assurance conditions in detail: concrete strength guarantee; concrete setting time guarantee; requirements for continuous concrete supply; guarantee of concrete supply quantity; concrete slump guarantee;

(2) Application for Concrete Pouring

To ensure all preparatory procedures meet quality standards prior to concrete pouring, a pre-construction cross-disciplinary review system and a ready-mixed concrete pouring application process must be established. The concrete pouring application, serving as part of the inspection documentation and final acceptance materials submitted to the supervision authority, must be completed by the subcontractor's technical documentation officer before pouring. This application requires co-signing by the general contractor's respective discipline engineers to confirm completion of all preparatory work. Upon successful co-signing, the concrete discipline engineer submits the application to the Quality Department, which then forwards it to the supervision authority for final inspection.

(3) Mechanical Equipment and Site Preparation

The on-site scheduling manager oversees the preparation of large and medium-sized machinery for concrete pouring, while planning the site routes to accommodate both the parking and movement of concrete mixer trucks. The chief dispatcher also coordinates the production equipment and transport vehicles at the concrete mixing plant.

4.6.3 Concrete Pouring

Concrete pouring should be uniformly distributed, and the pouring speed for columns should be controlled within a reasonable range, preferably around 2.5 meters per hour, to minimize lateral pressure on the formwork.

During concrete pouring, carpenters must be assigned to monitor formwork and scaffolding, while rebar workers should adjust the reinforcement. Concrete workers must use grinding plates and measuring rulers to smooth the finished floor surface, creating a flat rough finish. Construction joints must be pre-determined and left as straight seams. When continuing pouring at these joints, the concrete must achieve a strength of 1.2 MPa. The joints should be cleaned and moistened, with manual tamping performed within 1 meter of the joint. Plastic film should be available on-site. If rain occurs during pouring, immediately cover the unconsolidated concrete. During heavy rain, temporary ground joints should be set up, and pouring halted. After the rain stops, drain any standing water and remove rain-eroded concrete.

Concrete slump testing: All concrete shipments must undergo mandatory slump testing. The lab technician conducts random sampling of daily construction slumps, while the responsible engineer organizes personnel to verify each truck's slump value against the technical specifications in the commercial concrete invoice, with detailed test records maintained. Non-compliant batches must be returned to the batching plant and strictly prohibited from use. The project technical department establishes specific slump control parameters, with differentiated ranges for wall and floor slab components to accommodate their varying setting time requirements.

4.6.4 Column Concrete Pouring

A waste disposal opening shall be provided at the base of the column. After cleaning the column interior, it shall be sealed. The formwork shall be moistened with water, but no standing water shall accumulate at the base.

Prior to concrete pouring, a 50-100mm thick mortar layer matching the concrete's quality must be laid at the column base. The mortar shall be supplied by the commercial concrete supplier.

When casting columns in rows, the corner sections should be used first, starting from the exterior before moving inward, to ensure the verticality of the exterior components.

For 500mm-thick concrete slabs, insert a vibrator to compact the surface until reaching the column top. During vibration, avoid letting the vibrator stick to the surface layer to prevent premature compaction, which may disrupt

the concrete's layered structure. After insertion, perform vertical strokes with 50-100mm amplitude, allowing the vibrator to penetrate 50mm into the underlying layer to enhance bonding.

The vibrator should avoid contact with steel bars or formwork. Each insertion requires 20-30 seconds of vibration, and the vibrator must be withdrawn slowly to allow immediate concrete filling around the insertion point.

When the high-grade concrete is poured to the top of the column, it should extend to the beam and slab area as per the design requirements to prevent low-grade concrete from flowing into the column.

4.6.5 Beam and Slab Concrete Pouring

During the concrete pouring process for beams and slabs, the work should commence simultaneously after the column and wall concrete has fully set. As the inclined surface of the beam concrete extends, the slab concrete can be continuously poured and vibrated. When pouring concrete at the intersection of primary and secondary beams, if the reinforcement is too dense to allow effective vibration, a 30mm diameter small vibrator can be used. For slab concrete pouring, the initial thickness should be slightly higher than the slab itself. Once a working surface is established, a flat vibrator should be used to perform vibration, with the vibration direction perpendicular to the pouring direction, moving back and forth.

Each concrete pour is completed in one operation without construction

joints. Vibration should be intensified in critical areas such as column bases and core zones of joints.

Prior to concrete pouring, the construction team conducts inspections and verifications of reserved openings, gate closures, and embedded components, removes debris from the formwork, and moistens it with water.

Before pouring each concrete slab, the flow direction must be determined, and a dedicated pedestrian walkway should be laid on the slab surface to prevent random stepping on the reinforcement bars.

During concrete pouring, assign a dedicated inspector to verify the stability and structural integrity of formwork supports. Should any deformation or subsidence be detected, immediately halt the pouring process. The affected area must be repaired before the initial setting of the poured concrete, then resume construction.

After the concrete is compacted, the compaction, finishing and sanding work should be carried out in time.

The concrete vertical members were watered at room temperature for 14 days, and the horizontal members were watered for 14 days.

When the column and beam are not marked with the same grade, the pouring sequence should be carefully considered to prevent low-grade concrete from entering the core zone.

The test blocks for quality evaluation shall be sampled and fabricated under the supervision of the supervising personnel, and submitted for

inspection within the stipulated time.

4.6.6 Concrete Curing

This project employs the natural curing method, where concrete is covered with burlap sacks for watering within 12 hours after pouring. The frequency of watering should ensure the covering remains consistently moist. Standard concrete requires a curing period of at least 7 days under normal temperature conditions. For vertical components, after removing side formwork, burlap sacks are used to create a curtain-like covering for watering. Bottom surfaces of slabs and beams, as well as beam sides, are also maintained through watering.

4.7 Masonry Works

4.7.1 Raw Materials

(1) Masonry blocks: The types and strength grades of blocks must comply with design specifications, with uniform dimensions, accompanied by factory certification and test reports.

(2) Cement: The type and grade should be selected based on the masonry location and environmental conditions. Generally, 425 ordinary Portland cement or slag Portland cement is recommended. The cement must be accompanied by a factory certificate of conformity and test reports before use. Cement of different grades must not be mixed.

(3) Sand: Medium sand is recommended. When preparing cement mortar

or cement mixed mortar with a strength grade equal to or greater than M5, the clay content in the sand should not exceed 5%. For mortar with a strength grade less than M5, the clay content in the sand should not exceed 10%.

(4) Water: Clean water free from harmful substances shall be used.

(5) Lime slurry: The maturation time shall not be less than 7 days, and dehydrated hardened lime slurry is strictly prohibited.

(6) Other materials: tie bars, embedded parts, wooden bricks, waterproofing powder, etc. must meet design specifications.

4.7.2 Masonry Method

Bricks should be laid starting from the exterior wall corner or the positioning bricks. The bricks must be laid with their bottom surfaces facing upward, i.e., using the 'reverse masonry' technique where the holes are larger at the top and smaller at the bottom.

Masonry blocks shall be laid in sequence, with mortar joints kept perfectly level and vertical. All joints must be sealed with mortar, then the masonry wall shall be pressed into the required dimensions. The mortar filling rate for horizontal joints shall not be less than 90%, while that for vertical joints shall not be less than 60%.

All the mortar used in masonry should not only meet the requirements of strength, but also have good workability and water retention.

During masonry construction, both interior and exterior walls should be built simultaneously, with cross walls laid in staggered patterns. Upon

reaching a specified construction area, immediate joint filling should be performed.

No formwork openings shall be provided in the masonry. If required, side masonry can be used with block cavities serving as openings. After masonry completion, the openings shall be sealed with C15 concrete.

The connection between the structural column and the wall is built with a staggered joint. Along the wall height, two φ6 tie bars are installed every 600 mm, each extending into the wall by no less than 1 meter on each side and anchoring into the column by no less than 200 mm.

When the frame enclosure wall is filled with partition walls up to the bottom of the beam, the top 300 mm should be constructed with solid bricks in an oblique manner.

Wall corners and junctions shall be constructed simultaneously. For temporary gaps that cannot be built but must be left, a sloping joint shall be formed, with its length not less than two-thirds of the wall height. If a sloping joint is problematic, a horse-tooth joint may be used, provided that tie bars are installed.

4.7.3 Masonry Requirements

Table 4.6 Masonry Requirements Table

order number	Process Name	Specific construction requirements
1	mortar	The ready-mixed commercial mortar shall be used, and the mortar formulation must not contain sea sand. Mortar inevitably produces water bleeding and loss of consistency in containers, so it should be mechanically compacted before use to maintain its workability.

order number	Process Name	Specific construction requirements
2	wall body Brick another name for Guiyang	paying off: Before masonry, the wall axis position is set on the floor, the wall side line and the door and window opening position are set, and the elevation line is marked on the column.
		Lepidocarpus: Numbering posts shall be installed at each corner, with a maximum spacing of 15 meters. These posts must clearly indicate the dimensions and elevations of door/window openings, tie bars, ring beams, and lintels. All posts must be vertically aligned, securely fixed, and uniformly marked.
		Bricklaying: When laying the first course of masonry, the blocks should be arranged according to the actual dimensions of the wall section and the specifications of the blocks. If the blocks are not whole, they can be sawed to the required size, but the cut-off length must not be less than one-third of the block's length.
		bracing wire: Draw the centerline between the number of rods and the upper edge of the block, and then lay the block according to the centerline.
		masonry: The production age of block should not be less than 28 days. During masonry construction, the moisture content of blocks should be controlled. Aerated concrete blocks are recommended to have a moisture content of 5%-8%. Water should be applied appropriately to the masonry surface during the process. Prior to construction, a block arrangement diagram must be prepared according to the brick modulus to ensure proper alignment and staggered joints between upper and lower layers, with control lines marked on the columns. The masonry lines should account for the base brick modulus, block modulus, window sill elevation, and top position, and include layer number control lines and window sill elevations on both ends of each wall column. The mortar layer should not exceed 750mm in length, and the first batch of blocks must be fully laid. Immediately after placement, blocks should be positioned and leveled using a wooden hammer. During leveling, avoid inserting gravel or wood chips into mortar joints. If blocks need to be moved or become loose after masonry, all existing mortar must be removed. The vertical mortar joints between the top and bottom surfaces of masonry blocks shall be staggered, with a recommended offset of 300mm and a minimum offset of L/3 (where L is the block length). If this requirement cannot be met, 2 φ6 tie bars or φ4 steel mesh bars shall be installed in the horizontal mortar joints, with a minimum length of 700mm for the tie bars or steel mesh bars. At the corner of block walls, the transverse and longitudinal walls are interlocked, with the exposed ends of the interlocking blocks visible. At the T-joint of the wall, the exposed ends of the transverse wall blocks should be aligned with the longitudinal wall blocks. The reuse of ground dust in masonry construction can avoid material waste.
3	jointing	During masonry construction, the "slurry-sealing method" is employed, starting with horizontal joints before vertical ones. Mortar joints and block surfaces must be smooth and compact, avoiding missed joints, blind joints, cracks, or poor adhesion. This prevents wall water leakage and cracking, facilitating subsequent

order number	Process Name	Specific construction requirements
		plastering and decoration.
4	Key points of masonry	Masonry joints should be mortared, and tie-down measures should be provided where vertical and horizontal joints are not mortared. Additionally, a tongue-and-groove joint should be installed when connecting structural columns to walls. The daily masonry height should be determined based on the material properties of blocks and mortar, wall location, temperature, wind pressure, and other factors. Continuous masonry should be avoided to prevent uneven deformation or cracks in the wall. The recommended daily masonry height is 1.4m, and it should not exceed 1.2m during rainy weather.

4.8 Hydropower Installation Plan

4.8.1 Construction Procedures

The construction involves multiple disciplines such as civil engineering and installation, requiring seamless coordination among trades for cross-operation. In scheduling, each discipline must not only plan its own tasks rationally but also synchronize with other trades in both time and space. The general principle is to prioritize large-scale pipelines over small ones, underground work over above-ground, and concealed structures over exposed ones. Regular coordination meetings should be held, with the project's technical deputy manager overseeing the rational arrangement of construction procedures.

4.8.2 Water Supply and Drainage Engineering

(1) Construction Preparation

Upon arrival, thoroughly assess the overall site conditions and promptly

implement supporting measures including staff accommodation and land allocation for finished/semi-finished product processing.

The technical staff are thoroughly familiar with the construction drawings and fully grasp the design intent. They collaborate with the construction and design units to conduct drawing briefings and reviews, clarifying the design objectives. Based on reasonable feedback from all stakeholders, they refine the design drawings and meticulously document the briefing records.

The production schedules for major equipment, material quantities, prefabricated components, self-manufactured parts, and semi-finished products should be pre-arranged for processing. Based on the production schedule, the delivery timelines for equipment and key materials must be determined. When formulating material procurement plans, practical considerations must be prioritized. Economic principles require ensuring adequate material supply while preventing overstocking and waste. Accurate planning of material quality and specifications according to design requirements is essential to eliminate substandard procurement. Material officers must maintain detailed records, clearly distinguishing between incoming and outgoing materials.

(2) Construction Methods and Technical Requirements

Hot-dip galvanized steel pipes shall be used for pipe connections, and cold-dip pipes are strictly prohibited.

Mechanical threading is adopted to reduce manual threading and eliminate defects such as misalignment, broken threads, and burrs.

Pipeline fittings must also be made of hot-dip galvanized products to match the corresponding galvanized pipes. For threaded connections, wind the hemp thread clockwise, then thread it through the lead screw until only 2-3 threads remain.

The damaged galvanized coating or other areas of the galvanized layer during wire threading should be coated with two coats of rust-proof paint, followed by a silver powder coating.

Drainage risers shall be fixed and installed at intervals not exceeding 3 meters. Supports should preferably be installed at the socket, with the riser base secured using support pads or hangers. Horizontal pipes shall connect to each other at 45°, using diagonal tees or 90° straight-through tees. The riser base shall be connected to the discharge pipe via two 45° elbows. The slope of drainage horizontal pipes shall follow the table below, directing water toward the riser.

Pipeline anti-corrosion: For visible water supply pipelines, apply two coats of red lead anti-rust paint followed by two coats of silver powder paint. For buried pipelines, apply two coats of hot asphalt.

Installation of equipment and plumbing fittings: Sanitary fixtures (such as squat toilets and washbasins) must be correctly positioned, with brackets securely fastened without looseness. The connection between the drain outlet

and the drain pipe must be tight to prevent leakage. All components must operate with smooth operation, and valves must remain leak-proof when closed.

Valves, water pumps, and all materials must be accompanied by product qualification certificates and material certificates upon delivery, with performance sampling conducted prior to installation. Non-compliant products are strictly prohibited from installation. Before valve installation, a pressure resistance test shall be performed, with 10% of each batch (minimum 1 unit) tested. For shut-off valves installed on main pipelines, individual strength and tightness tests must be conducted. Water storage bends and floor drains provided with sanitary fixtures or as accessories shall maintain a water seal depth of no less than 50mm.

During pipeline installation, the principle of 'main pipe before branch pipe, large pipe before small pipe' shall be followed. When arranging pipelines, large pipes should be positioned inside and small pipes outside. The inspection opening of drainage pipes should face outward to facilitate maintenance.

During the installation of buried pipelines, a cushion layer or support should be prepared first, and anti-corrosion measures should be implemented. In case of rainfall during construction, measures to prevent water accumulation should be taken. When the part of the buried pipeline protruding above ground is temporarily not further constructed, the pipe opening should

be sealed to prevent debris from entering and clogging the pipeline.

When pipes penetrate walls, foundations, or floors, rigid or flexible sleeves must be pre-installed. For openings, ensure a minimum clearance of 110mm above the top of water supply pipes and 150mm above drainage pipes. Pipes passing through basements, underground storage tanks, or rooftop water tanks must be fitted with waterproof sleeves, and no post-construction openings are permitted.

4.8.3 Electrical Engineering

(1) Piping Engineering

Before laying electrical conduits, thoroughly remove dust, oil stains, or rust spots to prevent wiring difficulties. For manual rust removal, attach a steel wire brush to each end and pass it through the conduit, then pull it back and forth to clear rust. Except for the outer walls of steel pipes embedded in concrete, both inner and outer surfaces should be coated with rust-proof paint.

The wire conduit shall be connected with threaded joints, where the thread length must be at least half the pipe joint length. A bridging grounding wire shall be welded at both ends of the joint. Care must be taken to remove burrs from the pipe opening to prevent cutting the conductor insulation.

Thin-walled steel pipes should be bent using a pipe bender, ensuring no concave or convex areas or cracks appear during the process. The bending deformation should not exceed 10% of the pipe's outer diameter, with a bending radius of 6D (where D is the pipe's outer diameter). For thick-walled

steel pipes or those with larger diameters, gas welding can be used for heating and bending.

When the steel pipe enters the box or container, 2-4 threads should be exposed, and the ends should be secured with nuts. For wiring to the equipment, a metal flexible hose should be used for connection. When passing through the settlement joint, a metal flexible hose should be employed as a compensation device, with a certain amount of slack left in the hose.

(2) Wire threading within the tube

Wires must not be tied or spliced inside the conduit, and all wire connections should be made within switch boxes or junction boxes. During threading, apply both tension and pressure while avoiding forceful pulling to prevent wire breakage. After completion, inspect phase-to-phase insulation and ground insulation, documenting the results. If insulation resistance fails to meet specifications, investigate the cause and, if necessary, re-thread the non-compliant circuit.

The concealed distribution box is installed by first embedding the base box, then installing electrical components and secondary wiring. The base box is embedded in the wall, and its rear wall is secured with 10mm thick asbestos board and lead wire nails (2mm diameter, 10mm spacing) for reinforcement.

When installing switches and socket boxes, ensure they are flush with the wall surface without any tilt. Maintain strict control over vertical height

differences, with no more than 2mm for switches (or sockets) of identical shape within the same room, and no more than 0.5mm for row-mounted units. All switches must have the same disconnection direction, featuring reliable contacts and smooth operation. The distance between switches and door edges should be uniformly maintained within 150-200mm.

When installing cable trays and plug-in bus ducts, carefully follow the installation guidelines and observe the following key points: For horizontal cable tray installations, connect the joints at one-quarter of the span. When using the tray as a grounding trunk line, connect it to the main trunk line with a 16mm² copper core wire at the tray's end. Tighten the bus duct's bolted joints, ensure proper placement of insulation strips, and maintain clean, oil-free contact surfaces between conductive plates to prevent conductivity impairment.

4.9 Scaffolding Construction Plan

4.9.1 Overview

The double row floor steel pipe scaffolding is selected in this project.

4.9.2 Requirements for Setting Up Grounded Scaffolding

(1) Setup parameters

Construction method and key parameters: The scaffolding is constructed with φ48×3.0mm steel pipes and couplers, forming a double-row structure with a longitudinal span of 1500mm and a step spacing of 1800mm.

Wall connectors:φ25 (HRB400) steel bars are embedded in floor slabs or wall columns, with one horizontal bar spaced 4.5m apart per floor and one vertical bar placed every two steps.

The inner uprights shall be installed 300mm away from the wall, with a 900mm spacing between inner and outer rows of uprights. At the gap between inner uprights and the wall, a fine-mesh safety net must be laid in a fully enclosed manner, with a span of four steps.

The scaffolding's outer uprights are fully enclosed with a dense-mesh safety net on the inner side, and each floor is fully covered with 800× 1000mm steel mesh.

Shear braces shall be installed continuously along the entire length and height of the outer facade. Each shear brace shall have a minimum width of 4 spans (approximately 6 meters), with the diagonal members inclined at an angle of 45° to 60° from the ground.

The longitudinal and transverse sweeping rods are set at the bottom of the scaffolding 200mm away from the bottom surface.

The structural scaffolding is designed for a uniform construction load of 3 kN/m^2, considering simultaneous construction on both floors.

Starting from the second horizontal bar, install the footboards around the perimeter of the outer scaffold every two steps.

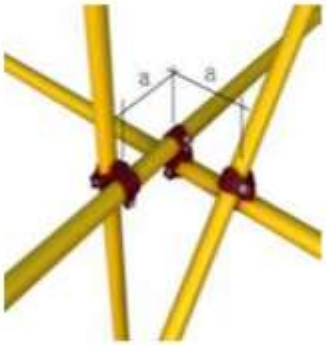
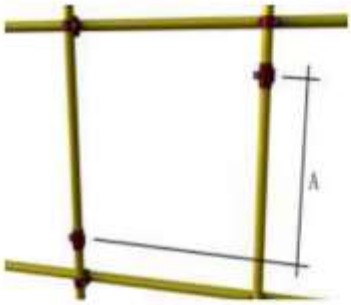
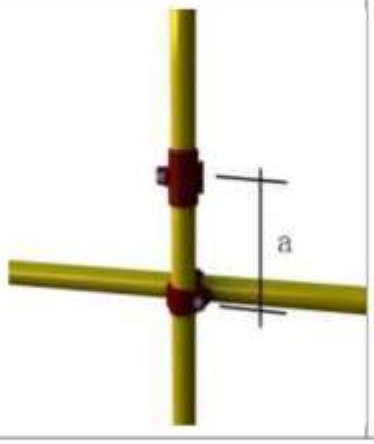
Lay 40×90 mm wooden planks at the bottom of the steel pipe.

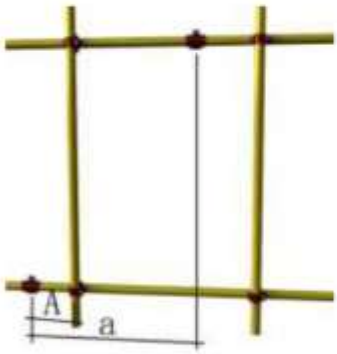
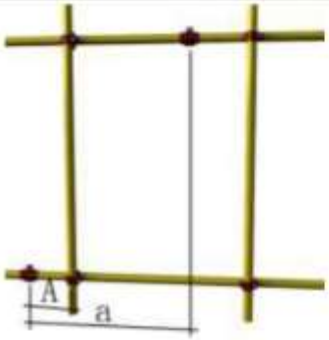
(2) Safety Technical Requirements for Landing Scaffold Installation

The first layer of scaffolding (at the second-floor slab level) must be fully covered, followed by full coverage at every four steps. The operating-level scaffolding boards should be laid completely and securely, with a clearance of less than 50mm from the wall. When boards are laid in an overlapping manner, a footrest bar must be installed. The outer side of the scaffolding must be enclosed with a fine-mesh safety net. All safety and technical requirements for scaffolding erection and dismantling must comply with the regulations.

Table 4.7 Safety Technical Requirements for Scaffold Installation and Dismantling

Item	project		technical requirement	allowable deviation (mm)	Diagnostic Methods and Tools
1	foundations	surface	Smooth and flat	—	observe
2		drain off water	No water accumulation		
3		backing board	Not shaking		
4		lamp stand	Do not slide		
5			non-sedimentation	-10	
6	verticality of support column		—	±30	theodolite
7	horizontal bar height difference		—	±10	gradienter
8	Deviation of the Outward Extension Length of the Horizontal Bar of Double		Extending 150mm	-20	plate gauge

Item	project			technical requirement	allowable deviation (mm)	Diagnostic Methods and Tools
	Row Scaffolding					
9	Fastener installation	Distance between the center points of fasteners at the main node	a≤ 150mm			tape
10		Height difference between two staggered couplers on a synchronous support pole	A≥ 500mm			tape
11		Distance from the butt joint on the support column to the main node	a≤h/3 (600 mm)			tape

Item	project		technical requirement	allowable deviation (mm)	Diagnostic Methods and Tools
12		Distance from the butt joint of the horizontal tie rod to the main node	A≤la/3 (500 mm)		tape
13		horizontal distance between adjacent horizontal tie bars	a≥ 500mm		tape
14		bolt tightening torque	40 ~ 60Nm	—	tension wrench
15	Inclination angle of diagonal member of diagonal bracing to ground		45o ~ 60o	—	square

4.9.3 Scaffolding erection

(1) Pole and sweeping pole

Pole Foundation: The scaffolding foundation of this project shall be

constructed with a C20 plain concrete base layer, with a minimum thickness of 100mm. Wooden pads with a minimum thickness of 50mm shall be installed at the top of the base layer and the bottom of each scaffold pole, ensuring even distribution and preventing any suspension. The spacing between scaffold poles shall be 1.5m, and the row spacing shall be 600mm. To prevent the outer scaffolding from tilting inward or outward, short steel pipes have been pre-embedded in the crown beam based on the actual site conditions. For the underground outdoor scaffolding, the connection components shall be steel pipes linking the outer scaffolding to the short steel pipes in the crown beam to ensure structural stability. The distance of the wall-attached poles shall be determined according to the pre-embedded steel pipes on-site.

Pole Connection: Pole extensions shall be connected using butt joints. Butt joints must be staggered: butt joints of adjacent poles shall not be within the same step distance, and two butt joints separated by one pole shall be staggered by at least 500mm in height. The distance from the center of each butt joint to the nearest main node shall be within one-third of the step distance.

Longitudinal and transverse sweep rods must be installed approximately 200mm above the base of the upright poles. The longitudinal sweep rod should be secured to the upright pole using right-angle couplers, while the transverse sweep rod should also be fastened to the upright pole directly

below the longitudinal sweep rod with right-angle couplers.

(2) Longitudinal horizontal bar structure

The longitudinal horizontal bar is positioned above the small crossbar and secured to the uprights on their inner side using right-angle couplers. Its length exceeds three spans, with all longitudinal horizontal bars at the same step intersecting at four corners. A single longitudinal horizontal bar is installed above the scaffold's small crossbar, directly connected to the uprights via couplers. These longitudinal bars are joined using staggered couplers, with joints arranged alternately. Joints are not aligned within the same span, and the horizontal distance between adjacent joints must be no less than 50 cm. Each joint must be no more than 50cm away from the uprights.

(3) Lateral horizontal bar structure

A transverse horizontal bar must be installed at the main node, secured with right-angle couplers and permanently fixed. The center-to-center distance between two right-angle couplers at the main node shall not exceed 150mm. For double-row scaffolding, the wall-end extension length shall not exceed 0.4L (approximately 300mm). Transverse horizontal bars at non-main nodes on working levels should be spaced equidistantly according to the required support for scaffolding boards, with the maximum spacing not exceeding half the vertical span.

(4) Scissor support structure

Scissor braces shall be continuously installed along the entire length and

height of the outer facade of the entire structure. Each scissor brace shall have a width of no less than 4 spans and a minimum length of 6 meters, with the diagonal bars preferably inclined at an angle of 45° to 60° from the ground.

The diagonal braces of the scissors support are connected by lap joints with a minimum lap length of 1 meter. They are secured with three rotating couplers, ensuring that the distance from the edge of the coupler cover plate to the end of the brace is no less than 100 mm.

The diagonal bar of the diagonal bracing is fixed firmly with the rotating fastener and the intersecting upright bar, and the distance between the center of the rotating fastener and the main node is controlled within 150mm.

(5) Scaffold Board Structure

The scaffolding boards shall be made of φ6 steel mesh with dimensions of 0.9×1.0m and a weight of 0.35kN/㎡, coated with anti-rust paint. The spacing between the bars shall not exceed 3cm. The board surface shall be smooth, free from cracks, open welds, or hard bends.

The scaffolding boards on the working level shall be fully and securely laid along the longitudinal horizontal bars, with butt joints. The four corners shall be secured to the longitudinal horizontal bars using galvanized steel wire ropes no less than 1.2mm in diameter.

The cantilever length of the scaffolding board at the end of the working layer shall be 150mm and must be securely fastened to the support rod.

(6) Wall joint construction

The wall connectors are rigidly assembled using a two-step, three-span configuration: 3.6m vertical spacing (two-step height) and 4.5m horizontal spacing (three-span distance). Embedded vertical steel pipes are installed in cast-in-place concrete beams and slabs. These pipes are secured with right-angle couplers at both ends: one end connects to the embedded pipes, while the other connects to the inner uprights.

The wall connectors should adopt a plum blossom pattern, with the wall rods arranged in both horizontal and vertical directions in a uniform sequence. They must be perpendicular to the scaffold and structural surfaces, and positioned as close as possible to the main nodes (within 30cm). The wall rods should extend beyond the couplers by more than 10cm. The arrangement of wall rods begins with the first longitudinal horizontal rod at the base, and all connections must use double couplers.

4.9.4 Dismantling of Scaffolding

(1) Demolition Preparation

Mark the work area with warning signs and prohibit unauthorized personnel from entering.

The fastener connection, wall connection, support system and so on of the scaffolding are checked to see if they meet the construction requirements.

The demolition sequence and measures in the construction organization design shall be supplemented and improved according to the inspection

results, and can only be implemented after approval by the competent authority.

The project technical lead shall conduct a safety briefing on demolition techniques and complete the signature process.

Remove debris from scaffolding and ground obstacles.

(2) Demolition sequence

Safety net → footboard and scaffold board → guardrail → diagonal braces → diagonal struts → horizontal crossbar → vertical crossbar → upright pole.

(3) Demolition Requirements

Scaffolding dismantling must be performed sequentially from top to bottom, with simultaneous vertical operations strictly prohibited. Each step and each support pole must be cleared thoroughly. Wall connectors must be removed layer by layer along with the scaffolding, and it is forbidden to dismantle the entire floor or multiple floors before removing the scaffolding. When the height difference exceeds two steps during segmented dismantling, additional wall connectors must be installed for reinforcement.

When removing horizontal struts, diagonal braces, or diagonal braces, first detach the intermediate couplers, then stabilize the middle section, and finally release the end couplers. All tie rods must be removed simultaneously with the scaffolding. It is strictly prohibited to dismantle entire floors or multiple floors of tie rods before removing the scaffolding. The height

difference for segmented removal should not exceed two steps. If the height difference exceeds two steps, additional tie rods must be installed for reinforcement.

The demolition sequence must be strictly followed, starting from the top down. Later-installed components should be removed first, followed by earlier-installed ones. Typically, the process begins with removing railings, scaffolding boards, and shear braces, then proceeds to horizontal crossbars, vertical crossbars, and upright poles.

Maintain unified command with coordinated actions between upper and lower levels. When unfastening fasteners related to another person, notify them first to prevent falls.

During the demolition process, a designated supervisor must be present to ensure safety. Materials must not be thrown indiscriminately from heights, and all components are strictly prohibited from being dropped onto the ground.

Wall connectors must be removed layer by layer with the scaffolding. It is strictly prohibited to dismantle the entire floor or multiple floors of wall connectors before removing the scaffolding. The height difference for segmented removal should not exceed two steps.

4.10 Decoration Works

410.1 Construction Sequence

4.10.2 Interior Wall Plastering

(1) Process Flow

Base layer cleaning and watering → vertical hanging, square nesting, plastering, and reinforcement → cement baseboard or wall skirt plastering → corner protection and plaster layer control line marking → base layer treatment → bottom mortar plastering → surface layer plastering → curing

Apply water from top to bottom with a rubber hose to moisten the surface one day before plastering.

Establish vertical and square alignment: First, set up vertical lines at door/window corners, cornices, and wall surfaces. Then, place plaster blocks and reinforce them with steel bars. Afterward, mark the plaster layer control line on the wall. The plaster blocks should be made into 50mm square shapes using 1:1 cement mortar.

The construction of interior wall, column surface and door opening corner shall comply with design specifications. Where design does not specify, 1:2 cement mortar shall be used for concealed corner protection, with a minimum height of 2m and a width of no less than 50mm on each side.

(2) Primary treatment

For concrete exterior wall panels, the base treatment involves roughening

the surface if it is too smooth. Two methods are available: First, use a pointed drill to remove the smooth surface, creating a rough texture, then moisten the base with water. Alternatively, clean the smooth surface thoroughly, remove oil stains with a 10% caustic soda solution, rinse off the alkali, and let it dry. Apply a layer of 1:1 diluted paste-like cement mortar (mixed with 20% water and 107 glue) using mechanical spraying or a broom, ensuring it solidifies firmly on the smooth base surface and is no longer movable when tapped.

The base layer is the brick wall: Clean the residual mortar, dirt, and dust on the wall surface, then water the wall to flush away the dust in the brick joints and moisten the wall surface.

Plastering Mortar Application: After completing the base layer mortar, the surface layer mortar can be applied the following day. First, moisten the wall surface and mark grid lines according to the blueprint dimensions. Install grid strips and drip troughs, then apply the surface layer mortar. The recommended mix ratio is 1:2.5 cement mortar or 1:0.5:3.5 cement blended mortar, with a thickness of 5-8 mm. Begin by dampening the surface with water. Apply a thin layer of plain cement paste to ensure adhesion to the base layer, followed by the surface plaster. Use a trowel to smooth the surface horizontally and vertically, then roughen it with a wooden trowel and finish with a smooth iron trowel. Once the surface is dry, use a soft-bristled brush dipped in water to lightly brush the surface in the same direction as the floor, ensuring uniform color and minimizing shrinkage cracks.

Plastering procedure: Apply the base layer from top to bottom. After completing the base layer, raise the scaffolding and proceed with the surface layer. Prior to applying the surface layer, inspect the base layer for voids or cracks. If any are found, chisel and repair them before proceeding. Additionally, ensure the base layer is thoroughly cleaned of dust and dirt. After moistening the surface with water, the plastering can be applied. The curing period must comply with regulatory requirements.

4.10.3 Exterior Wall Coating Project

This project utilizes textured stone paint for certain exterior walls. To ensure construction quality and meet moisture control standards for plaster surfaces, the coating application can only proceed when the plaster surface moisture content reaches 8%–10%. During application, strictly adhere to the product instructions for batch mixing and ensure complete use within the specified timeframe. Special attention must be paid to weather conditions; construction should be suspended during strong winds, heavy rain, or fog.

(1) Process Flow

Grassroots cleaning → corner and detail repair → drying → primer → drying → first coat of textured stone paint → drying → second coat of textured stone paint

(2) Construction Points

All oil stains and other contaminants on the base layer must be thoroughly cleaned.

The scaffold holes, wall-penetrating bolts, joints between aluminum alloy window frames and walls, as well as the chamfered edges of the base or substrate, should be repaired with 1:3 cement mortar during the construction of the original structure. The rough surface and gaps should be filled with putty.

Prior to applying primer, the wall dryness should be assessed, and a test sample should be conducted in a localized area.

The construction sequence of the coating is from top to bottom.

When the wall coating is applied in sections, the division line should be taken as the joint of the section, the corner of the wall or the water pipe.

Apply the same batch of paint to the same wall, with each coat kept thin to ensure even coverage and consistent color.

Apply the paint vertically with a dedicated roller from top to bottom, avoiding excessive back-and-forth strokes.

The consistency of coating materials should be adjusted according to their properties and ambient temperature during application, avoiding both excessive thinning and thickening to prevent bleeding and sagging.

4.10.4 Ground Engineering

(1) Cement mortar floor

The basic treatment→find the elevation and mark the line→water to moisten→mold the plaster and mark the tendon→mix the mortar→brush the cement slurry bonding layer→lay the cement mortar surface layer→wood

putty smooth→iron putty first pass→care.

Grassroots treatment: First, sweep away the dust on the grassroots. Use a wire brush and chisel to clean and remove the mortar skin and ash layer. Then, brush off the oil stains on the grassroots with a 10% caustic soda solution, and promptly rinse the alkaline solution with clean water.

Mark the elevation line: Starting from the +50cm horizontal mark on the wall, measure down to the surface elevation and mark it on the wall.

Watering: Spray the ground uniformly with a watering can.

Plastering grid and marking (or called chongjin): Based on the elevation mark line marked on the room's perimeter walls, determine the plastering thickness (no less than 20mm). Then draw a horizontal line to start the plastering grid (5cm×5cm), with horizontal and vertical spacing of 1.5-2.00. The top surface of the grid marks the floor elevation.

For larger rooms, to ensure uniform surface finish, it's essential to apply a screed (or' chongjin 'in Chinese). Spread cement mortar between the plaster blocks, matching their width, and use a wooden trowel to level it with the blocks' upper surface.

The mix proportion of mortar for plastering and marking is the same as that for floor plastering.

Mixing mortar: The volume ratio of cement mortar should be 1:2 (cement to sand), with a consistency not exceeding 35mm and a strength grade of at least M15. To control water content, use a mixer to ensure uniform

mixing and consistent color.

Apply a cement slurry bonding layer; before laying the cement mortar, a layer of cement slurry with a water-cement ratio of 0.4~0.5 should be applied (clean the residual plaster from the plastering tray and moisten it with water before application). Avoid applying an excessively large surface area, and apply the surface layer mortar immediately after brushing.

Apply the cement mortar surface layer. After applying the cement slurry, immediately proceed to lay the cement mortar. Distribute the mortar evenly between the mortar lines (or guide bars), then use a wooden trowel to smooth it to the height of the mortar lines (or guide bars). If the mortar lines (or guide bars) have already hardened during the application process, remove the used mortar lines (or guide bars) immediately after troweling, and fill the gaps with mortar.

Wooden smoothing: After scraping with a wooden scraper, immediately smooth the surface with a wooden spatula, working backward from the inside out, and check the flatness with a 2-meter straightedge at any time.

First, apply the initial layer with an iron trowel. After smoothing with a wooden trowel, immediately press down with the iron trowel until the mortar starts to flow. If the mortar becomes too thin and shows water bleeding, evenly sprinkle a layer of dry cement and sand (1:1 ratio, with sand sieved through a 3mm sieve). Then, use the wooden trowel to firmly press the dry mixture into the mortar, ensuring it bonds tightly. After the mixture absorbs

water, press down with the iron trowel to level it. For floors requiring division, mark the grid lines on the surface layer, use a jointer to create the joints, and then press the jointer to ensure the joints are flat, straight, and smooth. All these steps must be completed before the cement mortar begins to set.

Perform the second pass of troweling. After the surface mortar has initially set, if footprints are present but no subsidence occurs when stepped on, apply the second layer using an iron trowel while simultaneously filling in depressions. Ensure no areas are missed and achieve a smooth, polished finish. For floors with partitions, use a trowel to smooth the edges, ensuring the joints are straight, the gaps are clearly defined, and the interior surfaces are smooth and straight.

Third smoothing pass: Before the cement mortar reaches final setting, perform a third pass of smoothing (with slight footprints left when stepped on). When the iron trowel no longer leaves visible marks, use it to fully smooth, compact, and finish all residual marks from the second pass (this must be completed before final setting).

Maintenance. Within 24 hours after the surface is polished, cover with sawdust or other materials and water it to maintain moisture. The maintenance period should last no less than 7 days. The surface must achieve a compressive strength of 5MPa before it can be walked on.

(2) Floor Tile Installation

Process flow: Subgrade treatment → Leveling and marking → Laying

and leveling layer → Marking brick laying control line → Brick laying → Joint filling and smoothing → Curing → Installing baseboards

Operational procedure: Base layer treatment and elevation setting. Remove loose soil or mortar from the base surface, clean thoroughly. For oily stains, scrub with 10% caustic soda solution and rinse with clean water. Determine the slab elevation according to the +50cm horizontal line and design drawings.

Marking Control Lines: First, determine the required tile joint width based on the tile layout diagram. Standard widths are: 10mm for ceramic tiles, 3mm for full-wall tiles in bathrooms and kitchens, and 2mm for full-wall tiles in rooms and corridors. Then, mark the longitudinal and transverse control lines on the floor according to the layout and joint specifications. Ensure the cross lines align parallel with the wall plastering lines that maintain room squareness, and verify that the room width control lines are parallel to the corridor's longitudinal control lines. If misaligned, adjust them to ensure parallelism to prevent uneven edges in the color-matched tiles at doorways.

Bricklaying Procedure: To establish precise positioning and elevation, commence at the entrance by laying 2-3 longitudinal rows of bricks as reference points. Use these as guide marks to draw horizontal and vertical elevation lines. Proceed from the center outward, avoiding stepping on freshly laid bricks. Each brick must align with the lines. The workflow is: 1) Soak brick slabs in a half-filled bucket until fully moistened; 2) Allow them to dry

completely, ensuring no residual water remains; 3) Apply a thin layer of plain cement mortar (water-cement ratio 0.4-0.5) to the leveling layer, applying only as needed to avoid excessive coverage.

Binding layer thickness: A cement mortar binding layer is generally used, with a thickness of 10–25 mm. The laying thickness should be such that the tiles protrude 3–4mm above the surface elevation line when placed. After laying, use a large straightedge to level the surface, then compact it with a trowel to ensure evenness (the laying area should not be too large).

For the bonding layer mixing: use dry hard mortar with a mix ratio of 1:3 (by volume). The mortar should be mixed and used immediately, and consumed before initial setting to prevent affecting the bonding quality. The dryness of the mortar should be such that it can be molded into a ball by hand and will disintegrate upon contact with the ground.

When laying tiles, apply adhesive mortar to the back of the tiles facing upward, placing them on the pre-applied cement mortar. On the leveling layer, position the top edge of the tiles slightly above the horizontal datum line. After aligning, straightening, and square positioning, place wooden boards over the tiles and compact them with a rubber mallet. Proceed in a backward sequence from the interior outward, ensuring the mortar is fully filled, joints are tightly sealed, and the tiles are firmly set. For the junction with the floor drain, use a stone planer to shape the tiles to match the drain. It is advisable to lay floor tiles in one room at a time. For large-scale installations, adopt a

segmented approach, laying tiles in sections and designated areas.

Joint grouting and cleaning: The surface layer should undergo joint grouting and cleaning 24 hours after installation, using cement of the same type, grade, and color, or specialized joint filling material.

Joint filling: Use 1:1 fine cement mortar for joint filling, with the depth of the joint preferably being 1/3 of the brick thickness. The mortar within the joint should be compact, smooth, and even. Remove and wipe away any remaining cement mortar immediately after filling.

Joint filling: If the design requires very narrow joints, the joints must be kept straight. On the compacted and finished surface layer, pour cement slurry into the joints using a mortar pot, then sprinkle dry cement over the joints. Next, rub with a cotton ball to fill the gaps completely. Finally, wipe off the cement slurry from the surface layer.

Maintenance: After laying the bricks, water should be sprinkled for curing for at least 24 hours, and the curing period should not be less than 7 days.

(3) Door and window installation

Process flow: Marking lines for alignment → Door/window opening treatment → Inspection of installation connectors → Visual inspection of PVC windows → Transportation to installation site → PVC window installation → Sealing around door/window edges → Hardware installation → Project cleaning and acceptance

The back plug construction should be adopted in this process, and the structure construction should not be carried out after the vertical opening.

Check if the door/window opening is 3cm larger than the frame; if not, chisel it out first.

Line alignment method: First, locate the door/window edge lines at the highest level. Use a large plumb bob to lower the edge lines downward, then mark them at each floor level. For any irregular edges, chisel adjustments should be made. The horizontal position of doors/windows should align with the +50cm horizontal line of the floor. Measure the elevation of the window sill upward, then align the lines to ensure straightness. If the window sills at different elevations are on the same level, they must be aligned vertically.

Wall thickness orientation installation position: Determine the installation position of PVC windows and doors along the wall thickness based on the exterior wall detail drawing and window sill width. If the exterior wall thickness varies, the exposure dimensions of the window sill in the same room should be consistent. The window sill should extend 5mm below the PVC window frame.

The installation position line of door and window frame and the elevation control line of the vertical joint are placed according to the drawing size.

Install the iron feet on the door and window frames.

Window frame installation: Ensure correct positioning and reliable structural integrity.

Install door and window frames, align them with the marked lines to ensure verticality and elevation, and temporarily secure with wooden wedges. Check the verticality of the front and side surfaces as well as the diagonal alignment. After verification, use expansion bolts to firmly fix the iron feet to the structure. The required distance from the corner should be ≤200mm, with equal spacing ≤600mm. The anchoring depth of expansion bolts must comply with specifications (extended bolts should be used for critical positions). For vertical door frames: First, remove the lower fixing plate of the door frame. If the frame height exceeds the door panel height by more than 30mm, grooves must be cut into the floor on both sides of the opening. The door frame should generally be embedded 20mm below the ±0.00 elevation, ensuring uniform dimensions at the frame opening with allowable errors of <1.5mm for verticality and <2mm for diagonal alignment. Temporarily secure the door frame in the opening with wooden wedges. After verification, fix the wooden wedges and weld the iron feet to the embedded iron plates. Then, drill holes in the upper corners of the frame walls and pour M10 cement mortar into the frame. Assemble the door panel only after the mortar has solidified. The curing period for the poured cement mortar is 21 days.

The accessories for special doors must be complete, positioned correctly, and securely installed, with functions meeting both operational requirements and all performance specifications of the doors.

Positioning and temporary fixation: Install according to the pre-marked

installation lines, then align and level it. Once confirmed correct, use wooden wedges for temporary stabilization.

For fixing aluminum alloy doors/windows to walls, drill six 6mm diameter holes (80mm deep) along the exterior wall of the window frame at 600mm intervals, then secure them with expansion bolts.

Sealing gaps between door/window frames and walls: After installing insulated aluminum doors/windows, promptly seal the gaps between the frames and walls. If the design does not specify the type of filling material, use a foam agent to seal the gaps, leaving a 5−8mm groove on the outer surface for embedding sealant. Cement mortar must not be used for sealing.

4.11 Investment Plan and Guarantee Measures for Machinery and Equipment

In accordance with the construction deployment and schedule of this project, and adhering to the principle of meeting on-site construction needs, the following main construction machinery deployment plan is formulated.

4.11.1 Requirements Plan for Major Machinery and Equipment

Table 4.8 Proposed Machinery and Equipment Plan for Civil Engineering Section

rder um ber	Mechanical Equipment Name	ts	measure	natio nalit y plac e of prod uctio n	make a particular year	power rating (KW)	produc e ability	remarks
1	tower crane	TC5613	1		2014	/	normal	
2	Construction elevator	SC200/200	1	Gua ngzh ou	2015	111	normal	
3	bar straightener	GT6-12	1	Hen an	2015	5.5	normal	
4	angle bender	GW40	1	Fujia n	2015	3	normal	
5	bar cropper	GQ40	1	Tianj in	2015	1.5	normal	
6	straight thread machine tool	GX-40	1	Gua ngdo ng	2016	4	normal	
7	arc welder	BX-300	2	Beiji ng	2016	23.4	normal	
8	single side planer	MB105A	2	Shan ghai	2014	4	normal	
9	woodworking circular sawing machine	MJ-104	2	Heb ei	2015	2.5	normal	
10	submersible	WQ40-21-5.5	2	Ger α	2015	5.5	normal	

rder um ber	Mechanical Equipment Name	ts	measure	natio nalit y plac e of prod uctio n	make a particular year	power rating (KW)	produc e ability	remarks
	sewage pump			man y				
11	diesel generator	KTA38-G5	2	Gua ngdo ng	2015	250KVA	normal	
12	walkie-talkie	MOTORALA	0	Chin a	2015	/	normal	
13	concrete pumping machine	HBT-60	1	Chin a	2015	/	normal	
14	vibrating needle	ZN50	5	Hen an	2015	1.3	13m³/h	
15	Polisher	DMD800	2	Hen an	2015	5.5HP	800mm	

4.11.2 Key Measures for Ensuring the Use of Major Machinery and Equipment

(1) Inspection and Acceptance of Mechanical Equipment

The project equipment supervisor organizes relevant personnel to conduct inspections and acceptance procedures.

Inspect the completeness of the machinery, including the assembly quality of external structural components, the tightness and reliability of connection parts, the oil quality and quantity in lubrication areas and hydraulic systems, as well as the integrity of electrical systems. Complete the 'Mechanical Equipment On-site Acceptance Record'.

The project equipment supervisor organized relevant personnel to inspect the equipment's appearance, requiring the machinery to be clean and uniformly colored. Installation could only commence after passing the final inspection.

Prior to installation, large-scale special equipment such as tower cranes and construction elevators must have an approved installation plan.

(2) Equipment Acceptance

Upon completion of equipment installation, the project and installation unit shall conduct acceptance inspection and fill out records according to the acceptance forms issued by relevant government departments. Upon passing the inspection, the original documents shall be submitted to the project equipment supervisor, while copies shall be filed with the materials engineer for archiving.

After equipment acceptance, the project equipment supervisor must verify the operator's qualification certificate (for operators from other provinces, a Special Operations Work Permit issued by the provincial labor department or relevant authority of the People's Republic of China is required)

and retain a copy for archival purposes before commencing construction. Only upon passing this verification can the operator proceed to the site for work.

Chapter 5 Construction Schedule

5.1 Schedule Analysis and Overall Deployment

The total construction period of this project is 410 calendar days. To ensure the achievement of the total construction period target, it is necessary to divide the project into flow segments, organize labor forces reasonably, mobilize the best personnel of the unit, ensure sufficient turnover materials and advanced construction machinery and equipment, and organize construction strictly according to the project method.

5.1.1 Construction Preparation Phase Duration

(1) Construction preparation work contents:

Survey and layout; electrical capacity expansion; pipeline geophysical exploration, relocation and protection; installation of temporary water and power pipelines for construction; temporary road construction; site leveling and hardening; temporary construction facilities and building erection; machinery and equipment transportation; other preparatory work.

(2) Schedule of Construction Period

The construction preparatory work involves temporary facility erection and road construction with substantial workloads, scheduled for a 5-day period.

5.1.2 Overall Schedule

The master schedule is a strategic blueprint for the entire construction

project, developed based on construction drawings and other technical documents. It comprehensively considers all aspects to outline the overall construction timeline, define the start and end dates of key phases, and establish the sequence and coordination of individual or sub-projects. Through calculations, it identifies critical path routes and prioritizes key tasks. Additionally, it analyzes and forecasts to determine the required economic performance levels and corresponding measures. For specialized construction activities, the master schedule thoroughly addresses these aspects and incorporates relevant details into the plan.

The overall progress control plan must be submitted to the owner and the supervision company for approval before implementation, and shall be subject to their supervision and inspection.

The project is tentatively scheduled to commence on August 20,2025, with completion expected by October 3, 2026, spanning 410 calendar days. For detailed timelines, please refer to the progress schedule Gantt chart and network diagram.

5.1.3 Monthly and Weekly Work Plans

On the basis of the overall implementation schedule, the project should also be carried out by preparing monthly and weekly work plans. These plans should be detailed and broken down to the team level, ensuring that construction tasks are effectively implemented to meet the requirements for guiding construction.

5.2 Key Points in Construction Plan Preparation

5.2.1 Key Nodes and Critical Paths

When developing a construction schedule, the initial step involves thoroughly analyzing the project's scope, technical specifications, interdependencies among trades and processes, and contractual timelines. This analysis identifies critical milestones and key constraints affecting the schedule, enabling the calculation of the critical path. Once the critical path is established, monthly and weekly work plans along with safeguard measures are formulated around this core element. The plan emphasizes the critical path's pivotal role in the entire project through production scheduling, organizational coordination, and technical oversight.

5.2.2 Integration with Construction Techniques

Construction technology and project management are closely interrelated. Optimizing construction techniques and plans not only shortens the absolute construction period but also reduces unnecessary expenses. Therefore, project management should be integrated with construction technology. By employing scientific construction methods and plans, we can ensure the full realization of the overall construction schedule, thereby demonstrating the advancement of planning.

Chapter 6 Organizational Measures to Ensure Construction Period

6.1 Organizational Command and Assurance Measures

Establish an efficient engineering command structure, with the commander leading the command center to oversee the project schedule. The command center for this project will be staffed by highly qualified personnel with extensive experience in key construction management, serving as both the commander and project manager. They possess the absolute capability and expertise to lead the entire management team in completing the construction tasks on schedule.

The project is decomposed according to the project structure, the project progress stage and the contract structure, and a coding system is established.

6.2 Ensuring Human and Material Resources

To ensure the construction period, we should set up a full-time labor force deployment officer, select a professional operation team with high quality and strong team, and concentrate manpower to carry out the construction of the key line engineering project, so as to ensure the construction period.

To address the challenge of ensuring sufficient material supply during peak construction periods, the following measures have been implemented: The construction site's internal roads are strategically arranged to enable direct material delivery to work areas, thereby reducing material arrival time.

Additionally, we maintain reliable supply channels and coordinate with alternative procurement routes. This ensures that backup supply channels are available when primary material sources face disruptions, guaranteeing uninterrupted project progress.

All machinery and equipment for this project have been secured, with rental agreements finalized for necessary equipment. On-site inspections confirm the leased construction machinery is in optimal working condition.

(1) Material Usage and Allocation

According to the construction schedule in the construction organization design and the analysis of labor and material in the construction budget, the material quantity plan of the project is prepared, and the materials are brought into the site according to the plan, and the use and allocation are arranged uniformly.

(2) Allocation of construction machinery and equipment

Set up a full-time mechanical equipment dispatcher, responsible for the unified allocation of large-scale construction machinery, reasonably arrange the construction of various large-scale construction machinery, improve the utilization rate of machinery, and concentrate on ensuring the construction of key projects to ensure timely completion.

Chapter 7 Construction Layout and Plan Design

7.1 Construction Layout

7.1.1 General Provisions

The site of this project is small, in order to ensure the smooth traffic in the construction site and the safety and civilized construction of the project, reduce the mutual influence and efficiency of the materials and tools on the site, the site plane should be arranged scientifically and reasonably.

7.1.2 Current Status of the Construction Site

The proposed construction site currently features highly accessible external transportation, with a leveled site and a reserved earthwork access route to the south. The site has essentially achieved the 'three accesses and one leveling' standard.

Main issues at the construction site: The site is relatively small, with virtually no space allocated for material storage or processing around the retaining slope. Upon arrival, a reinforced concrete platform will be erected on the northern side of the construction site to serve as a permanent facility for steel bar processing and material storage. The workers' dormitory area will be arranged outside the site.

7.1.3 Layout Principles

To ensure a compact and well-organized construction site layout and

smooth on-site operations, the following principles are established for the construction site layout:

The general layout of the construction is arranged in three stages: foundation construction, main body construction and decoration construction.

The tower crane and construction elevator should be arranged reasonably, and the construction road and site should be planned well to reduce transportation cost and secondary handling in the site.

It meets the requirements of on-site health, safety, fire prevention and environmental protection.

7.2 Plan Drawing Design

According to the master plan, the project features a TC5613 tower crane on the south side and an SCD200/200 construction elevator on the west side. The southern area includes a steel bar storage and processing yard, a carpentry workshop, and a steel pipe coupler storage area. The office is located on the south side, while the dormitory is situated on the east side. For detailed layout specifics, please refer to the master plan.

7.3 Provision of Temporary Water

7.3.1 Calculation of Temporary Water Consumption

The water supply at this construction site comprises five primary components: engineering water, machinery water, construction site domestic water, residential area water, and firefighting water. Specifically, construction

site water is mainly allocated for concrete curing and formwork watering, while machinery water serves welding machines, cold-drawing machines, carpentry workshops, and pressure testing pumps. The allocation of construction site and residential water is determined by peak construction manpower. The site only provides a living quarters for management personnel, with workers' accommodations located off-site.

Table 7.1 Water Consumption Calculation Table

water consumption for engineering	The water consumption q1 for engineering purposes is calculated using the formula q1=k1 × (Q1N1K2 / (8 × 3600)).
	K1—Unforeseen construction water coefficient, take 1.10
	Q1—Planned work volume per shift, with 200m³ of concrete per shift
	N1—Water consumption quota for construction, using ready-mixed concrete with only natural curing considered, with a water consumption of 300L
	K2—Unbalanced coefficient for on-site construction water supply, set at 1.5
	Water consumption for engineering purposes: q1=1.10 × 200 × 300 × 1.5 / (8 × 3600) = 3.45 L/s
water consumption of construction machinery	The water consumption q2 for construction machinery is calculated using the formula q2=k1 × (Q2N2K3/8 × 3600).
	K1—Unspecified construction water coefficient, take 1.10
	Q2—For the same number of machines, select the primary water-using equipment, i.e., 1 pressure test pump
	N2—Water quota for construction machinery shifts, with a test pump capacity of 1× 300L
	K3—Water consumption imbalance coefficient for construction machinery, set at 1.15
	Water consumption for construction machinery q2=1.10 × 1 × 1 × 300 × 1.15 / (8 × 3600) =0.013
Water consumption for domestic use	The daily domestic water consumption q3 is calculated using the formula q3 = P1N3K4/(t×8×3600), where: P1 = peak daily and nighttime occupancy at the construction site (124 people); N3 = domestic water consumption quota (40L/person); K4 = uneven coefficient (1.5). t—Number of daily work shifts, with two shifts per day;

	The daily domestic water consumption q3 is calculated as 124×40×1.5/(2×8×3600), yielding 0.129L/s.
fire demand	For fire water consumption calculation (q4), the construction site area is less than 25 hectares, so q5 is set at 15 liters per second.
Total Water Consumption and Pipe Diameter Selection in Construction Site	Total water consumption Q at the construction site is calculated as follows: Since q1 + q2 + q3 <q5, Q = q5 = 15 L/s d = √4Q/πv1000 d — Diameter of the water distribution pipe (m) The water flow velocity in the pipe network (m/s) is 1.5 m/s. The total water consumption at the construction site and the pipe diameter selection are determined accordingly. d = √4×15/(π×1.8×1000) = 0.93m, the selected pipe diameter is 100mm

The main water supply pipes for construction shall be DN100 galvanized steel pipes; branch pipes for construction shall be DN50 galvanized steel pipes; branch pipes for residential areas shall be DN25 galvanized steel pipes; and branch pipes for firefighting shall be DN100 galvanized steel pipes.

For water supply to the upper floors, a 50m head booster pump is installed on the ground floor to provide water for both residential and firefighting purposes. The main water supply and fire protection pipes in the tower building are both 100mm in diameter, while each floor's distribution point uses DN20 galvanized steel pipes.

Chapter 8 Labor Input Plan

8.1 Labor Implementation

The on-site construction teams must undergo rigorous qualification screening, with each crew required to have a part-time quality inspector to ensure immediate cleanup after work.

The dynamic management of the teams that have entered the site is implemented, and they are not allowed to expand or withdraw at will, so as to ensure the quality and personnel stability of the construction team.

Operational tasks not covered by the project department's quality and safety training are not permitted. Strengthen the management of labor units, requiring all on-site labor units to be equipped with a certain number of full-time dedicated personnel responsible for coordinating quality and safety.

8.2 Key Links in Labor Force Organization and Management

Labor organization and management during decoration and finishing phases are critical to the project's success. To ensure smooth progress, we will implement the following measures:

The project management team and supervising foreman must conduct a comprehensive assessment, thoroughly study the construction drawings, and fully grasp the design intent. They should plan the manpower deployment for each phase of the project, specifying when workers will arrive and depart, to ensure clear planning and minimize uncertainty. This approach helps prevent

unnecessary staff shortages or idle labor.

The system of competitive employment should be implemented to prevent the phenomenon of working without effort and reworking.

8.3 Labor Schedule

n Table

Job Title	Investment in labor force by project implementation stage			
	foundation work	main work	Decorative Engineering	finishing works
Reinforcing iron worker	15	20		
carpentry	10	15	4	
Concrete worker	5	6	2	
brickwork	20	25	30	4
lineman	5	5	5	4
plasterer	10	10	20	10
Operator	5	5	5	5
Mechanic	2	2	2	1
electrical engineering	3	3	3	1
Test worker	1	1	1	1
electric welder	4	4	2	1
General Worker	5	5	5	5
ensure public security	4	4	4	4
waterproofer	4	4	4	
install	5	15	20	2
amount to	98	124	107	38

During the peak period, 124 workers were involved in the main structure construction.

Chapter 9 Quality Assurance Measures

9.1 Quality and Technical Support Measures and Resource Support Measures at Each Stage

Strictly implementing ISO9002 quality standards, conducting quality management according to procedure documents, and performing operations based on work instructions are the fundamental guarantees for maintaining stable and continuously improving quality levels.

Strengthen technical management by strictly implementing national regulations, operational procedures, and management systems. Clearly define quality responsibilities and conduct thorough technical briefings. In addition to written briefings, organize team meetings to explain construction techniques and operational methods.

All materials must be properly classified, neatly stacked, and clearly labeled. Strengthen the inspection of raw materials and strictly enforce the material inspection system. Cement, steel bars, steel pipes, and steel wire ropes must all come with factory certificates of conformity and test reports. Concrete must be poured strictly according to the mix design, with thorough implementation of the opening briefing and formwork removal application procedures.

Quality assurance measures for each process:

9.1.1 Surveying and Layout

The survey utilizes a GTS-102n total station with technical specifications including: J2-grade theodolite accuracy, Class II precision, 1000m ranging capability, and I-class measurement accuracy (5+5PPm), fully meeting the project's planimetric requirements. The elevation survey employs an SL-class automatic leveling instrument. A dedicated surveying team is established, with all instruments and tools undergoing pre-measurement inspections and periodic calibration. The primary focus of the control system is to ensure vertical alignment of structures.

9.1.2 Formwork Construction

(1) The stent must comply with the relevant requirements for material selection and composition, and must also meet the following specifications

Ensure the correct shape, size and mutual position of the structure and components.

It has enough bearing capacity, rigidity and stability, and does not cause unacceptable sinking and deformation.

The structure is simple, easy to assemble and disassemble, and convenient for the construction of the follow-up process.

The inner surface of the template must be smooth with tight joints, and no mortar leakage should occur at the joints.

The design, fabrication, and installation of formwork shall comply with

the relevant provisions of current national standards. When determining the dimensions of wooden formwork, consideration must be given to the requirements for assembly and jointing, with appropriate adjustments made to the length of specific sections.

(2) Template installation must comply with the following requirements

For cast-in-place reinforced concrete beams and slabs, the formwork shall be arched as required by the design. In the absence of specific design requirements, when the span is equal to or greater than 4m, the arch height should preferably be 1/1000 to 3/1000 of the total track length.

When implementing a layered and segmented formwork system, the installation of upper-level formwork and its supports must comply with the following requirements: The lower floor slab must either possess sufficient load-bearing capacity to support the upper floor or be reinforced with additional supports. The upright columns of the upper-level supports should be precisely aligned with those of the lower-level supports, with spacer plates laid between them. All embedded components and reserved openings fixed to the formwork must be fully installed, ensuring secure fixation and accurate positioning. Special attention should be paid to controlling deviations during formwork installation.

Upon completion of the formwork construction, the axis alignment, elevation relationships between adjacent elements, geometric dimensions, shapes, and verticality must be verified according to design specifications. All

components should be rigorously inspected for structural integrity. Concrete pouring may commence only after passing verification by the quality and safety supervisor and technical staff. During the pouring process, designated personnel shall conduct regular inspections. Any detected deformations or loosening must be promptly corrected to ensure structural stability.

9.1.3 Reinforcement Construction

(1) The type and quality of steel reinforcement must comply with design and specification requirements.

The grade and performance of welding rods and fluxes must comply with the design specifications. Reinforcing bars shall be accompanied by factory quality certificates or test reports. Upon arrival, they shall undergo batch-by-batch inspection and may only be used after passing the inspection. During storage, they shall be stacked in neat batches to prevent rust or oil contamination.

(2) Steel bar processing

The grade, type, and diameter of steel bars shall comply with design specifications and shall not be substituted without authorization. The processed shape and dimensions must meet design requirements.

The surface of the reinforcing steel bar shall be clean and free from damage. Oil stains, paint residues, and rust must be thoroughly removed before use. Reinforcing steel bars with granular or flaky old spines shall not be used.

Reinforcing bars shall be straight without local bends. Straightening of bars shall comply with relevant regulations.

The bending hook or bending of the steel bar shall comply with the regulations.

(3) Rebar Binding and Installation

The stirrups of beams and columns shall be arranged perpendicular to the load-bearing steel bars. At the overlapping points of stirrup hooks, they should be staggered along the direction of the load-bearing steel bars. When vertical steel bars are spliced in columns, the angle between the hook plane of the steel bars and the formwork surface must comply with the relevant specifications.

The dimensional deviations of the binding net and binding framework shall be controlled within the permissible limits specified in the standards. The allowable deviations for the installation of reinforcing bars and the positioning of embedded parts shall comply with relevant regulations.

The lap length and end hooks of the reinforcement binding joints shall comply with the relevant provisions of the specifications; the reinforcement lap joints shall be securely tied with wire at the center and both ends.

9.1.4 Concrete Construction

Cement must be accompanied by a quality certification and should undergo inspection for its type, grade, packaging, and production date. If there are doubts about the cement quality or if the cement has been stored for

more than three months (one month for fast-setting Portland cement), retesting should be conducted. Aggregates must comply with relevant regulations.

Develop a qualified concrete pouring plan based on the characteristics of sub-projects and specific conditions. Prepare sufficient vibrators and other equipment as needed, with backup quantities for potential failures.

Concrete mix proportions must be determined through laboratory testing, considering environmental factors such as temperature and humidity, in accordance with the required strength grade specified in construction drawings, along with the mixing workup and setting time dictated by construction techniques. Only after passing laboratory tests can the mix be officially used. Strict adherence to the mix proportions is mandatory for material measurement and feeding. Careful inspection of the quality, quantity, slump, and mixing time of concrete components is essential, with test blocks prepared as required. Both the concrete mix proportions and cement physical and chemical test reports must undergo verification by the design unit and the supervising unit.

9.1.5 Masonry Works

(1) Material Requirements

When purchasing blocks, a factory certificate of conformity or test report must be provided, and the type and grade must meet the design requirements.

Select cement and provide the factory certificate of conformity or test

report.

The quicklime should be fully calcined, with a calcination time of no less than 7 days.

First, thoroughly remove the mortar and debris from the surfaces of the foundation, waterproof layer, and floor slab, then moisten them with water.

(2) Masonry Construction

The masonry should be used in construction only after it has reached the required age since the date of production.

During masonry construction, the moisture content of the masonry should ideally be maintained at 8% to 12%. The use of dry bricks or bricks with saturated moisture is strictly prohibited. Prior to masonry, the area should be moistened two days in advance. Immediate masonry after pouring is not recommended, nor should construction be carried out on rainy days.

The daily masonry height should not exceed the height of one step scaffold or 1.5 meters.

The masonry should be staggered vertically and laid with overlapping layers.

The mortar saturation of horizontal joints shall not be less than 80%. Vertical joints should preferably be filled with grout by extrusion or injection, and transparent joints must be avoided. Water flushing is strictly prohibited.

The thickness of horizontal and vertical mortar joints in masonry should preferably be 10mm, but must not be less than 8mm or exceed 12mm.

The technique of wall-top pressing: A layer of approximately 600mm of lime-sand bricks is obliquely laid between the wall top and the beam bottom, tightly pressed up and down, and then filled with masonry mortar to ensure density.

9.1.6 Decoration Works

(1) Plastering work

The corresponding construction procedures shall be adopted according to the plastering grade specified in the design requirements.

The average total thickness of the plaster layer shall not exceed the limit specified in the code, and it should be applied in layers. The recommended thickness for each application of cement mortar is 5–7 mm, while for lime mortar and cement-mixed mortar, the recommended thickness is 7–9 mm.

For plastering with cement mortar or cement-mixed mortar, the subsequent layer must be applied only after the previous layer has fully set. For lime mortar, the subsequent layer should be applied only when the preceding layer is 70-80% dry.

The plastering surface shall meet the following requirements: For ordinary plastering projects, the surface shall be smooth and clean with flat joints; for intermediate plastering projects, the surface shall be smooth and clean with flat joints, clear lines, and square corners; for advanced plastering projects, the surface shall be smooth and clean with uniform color, no plastering marks, and flat line joints and plaster lines.

(2) Floor Engineering

Apply the slab surface layer over the sand bonding layer (or bedding layer). Before laying, water the sand bedding and bonding layer, compact them, and level with a scraper.

Plank panels must be pre-soaked in water before installation on the cement mortar bonding layer, and can only be laid when the surface is completely dry. The bonding layer and panels should be installed in sections simultaneously, avoiding the use of grouting methods. All joints between panels, between panels and the bonding layer, as well as at wall corners, edges, and wall-contact areas, must be tightly sealed. There must be no gaps between the panels and the bonding layer, and mortar filling should never be used to replace the panels at wall-contact areas.

The tiling work of the slab shall be completed before the mortar sets. During tiling, the slabs must be laid flat and correctly embedded. After a construction interval, the bonding layer material squeezed out from the already laid slabs shall be removed before resuming tiling.

The slab surface layer laid on the cement mortar bonding layer should be filled with diluted cement slurry or 1:1 diluted cement mortar within 1 to 2 days after paving.

Prior to granite surface installation, pattern and texture matching with numbering should be performed. During tiling, centerline cross-strips should be marked per room, and standardized blocks should be laid with smooth,

compact surfaces. Post-installation, the surface must be protected. Waxing for a glossy finish can only be applied after the bonding layer's cement mortar reaches 60-70% strength.

9.2 Prevention of Common Quality Defects at Each Stage

9.2.1 Formwork Engineering

Before installing the template, inspect its quality. Any template failing to meet the quality standards must not be used.

(1) Beam formwork

Common problems: beam body not straight, beam bottom not flat and bending downward, side formwork burst, local formwork embedded in column beam, difficult to dismantle.

prophylactico-therapeutic measures ：

When setting up formwork, the principle of edge form wrapping bottom form should be followed. At the connection between beam formwork and column formwork, the cutting size should generally be slightly shortened.

The beam side formwork must be equipped with pressing feet, diagonal braces, and straightened tie rods before the beam is nailed in place. The bottom formwork of the beam shall be arched as specified.

Before pouring concrete, the formwork should be thoroughly watered.

(2) Column formwork

Common defects: mold cracking, cross-section bulging, leakage, poor

compaction, or surface defects such as pitting, skewing, and column distortion.

prophylactico-therapeutic measures ：

The column clamps should be fastened according to the specified spacing requirements.

When setting up a row of column formwork, first erect the two end columns, straighten them and verify their positions. Then draw a straight line at the top, and finally erect the middle column.

The four-side braces should be firm.

(3) Board template

Common defects: the middle part of the slab is sagging, and the bottom of the slab is uneven.

prophylactico-therapeutic measures ：

The floor slab formwork thickness should be uniform, the joist material should have sufficient strength and rigidity, and the surface of the joist should be smooth.

The support top must meet the requirements of the guaranteed items.

The plate mold is arched according to the regulations.

9.2.2 Reinforcement Work

(1) Preventive Measures for Common Quality Defects of Vertical Reinforcement Misalignment

Before setting up the formwork support system for frame columns and

shear walls, it is advisable to embed Φ12 steel bar heads or Φ48 short steel pipes as support points on the cast-in-place concrete floor, with a spacing not exceeding 1 meter. The diagonal braces should be securely connected to these support points to provide top support, counter-tensioning, and vertical alignment adjustment.

When drawing review and steel bar layout, pay attention to the arrangement of beam and column steel bars, and minimize the displacement of vertical main steel bars caused by arrangement problems.

At the dense reinforcement zones of beam-column joints and column-beam junctions, install a positioning stirrup for frame columns and hidden columns during reinforcement binding. Secure it to the beam stirrup with spot welding, then tie the main column reinforcement in sequence. Temporarily install stirrups spaced no more than 500mm along the column height to prevent displacement of column reinforcement during concrete pouring.

At a height of 500mm above the floor level, horizontal rebars with a minimum diameter of φ12 are used to temporarily secure the vertical rebars in their intended alignment. Subsequently, 16-gauge lead wires are applied to the formwork or floor reinforcement in a direction perpendicular to the horizontal rebars, ensuring proper spacing and alignment of the vertical rebars. This method effectively prevents misalignment during material cutting and vibration processes.

Enhance on-site concrete pouring management by conducting thorough technical briefings. Strictly prohibit pouring entire truckloads or concrete mixers directly into columns. Avoid random impacts on structural steel reinforcement frameworks. Concrete should first be unloaded onto a concrete tray, then evenly distributed and poured in layers with proper vibration. This method ensures construction quality while preventing deformation of reinforcement frameworks.

Before performing the lapping, welding, and mechanical connections of vertical reinforcement bars, scaffolding must first be erected. Using suspension lines and steel pipes to secure the upper support positions, the extended reinforcement bars can be precisely positioned within the stirrup range. This method ensures safe installation of column reinforcement bars and stirrup binding on the scaffolding, while preventing distortion or tilting of the frame column skeleton and enhancing work efficiency.

(2) Steel bar processing

Inaccurate cutting dimensions of steel bars: Adjust or redo the work based on the structural location of the bars and the resulting errors.

The rebar forming dimensions are inaccurate, with the stirrups skewed and the shape deviation exceeding the permissible quality standard. For Grade I rebar, only one re-straightening and bending operation is permitted; other grades should not undergo repeated re-straightening or bending.

(3) Rebar Binding and Installation

Inaccurate dimensions of steel bar framework: When tying, align the ends of multiple steel bars to prevent deviation from the specified position and deformation of the framework.

The thickness of the protective layer mortar block should be accurate, and the spacing of the blocks should be appropriate; otherwise, it may cause cracks on the flat cantilever plate surface and expose the reinforcement bars at the bottom of the beam and the side of the column.

When hoisting the steel skeleton into the formwork, it should be done as smoothly as possible. The steel skeleton should be lifted with a "shoulder pole", and the lifting points should be determined in advance according to the shape of the skeleton. The intersections of the steel bars should be securely tied, and welded if necessary.

After the steel bar reinforcement binding is completed, the bars may exhibit a diagonal alignment. During binding, the steel wire should be tied in a figure-eight pattern. If any missing stirrups or incorrect spacing are detected during left and right side binding, immediate adjustments must be made.

Column stirrup joints must not be misaligned. Prior to binding, inspection must be conducted. After binding is completed, re-inspection should be performed. Any errors identified must be corrected immediately.

When the side pressure of the concrete pouring is affected, the position of the steel bar is adjusted in time.

When the number of steel bar joints per cross-section exceeds the code

requirements, verify the welding quantity before binding the framework. If it exceeds the code requirements, adjustments must be made before binding to ensure proper formation. This prevents common quality issues in flash welding.

9.2.3 Concrete Engineering

(3) Concrete pouring

Cellular structure. Causes: inadequate vibration or missed vibration; excessive formwork gaps leading to cement slurry leakage, overly dense reinforcement, or correspondingly oversized gravel.

Precautions: Use and handle vibrators strictly according to specifications. When pausing mid-process to resume pouring, carefully tamp the new-old joint area. Before formwork installation, thoroughly clean the surface and joints to ensure a tight seal. If the joint width exceeds 2.5mm, seal it with filler. For beams with dense reinforcement, select appropriate aggregate particle size.

Reinforcement spalling. Causes: Insufficient spacers in the main reinforcement cover, causing the bars to adhere to the formwork; inadequate vibration.

Preventive measures: The thickness of the steel bar spacers must comply with the design-specified cover thickness. Spacers should be placed at appropriate intervals, with closer spacing for smaller-diameter bars to minimize deflection caused by their own weight. When using vibrators, they

must remain stationary until all air bubbles in the concrete are completely expelled.

Pockmarked surface. Causes: Uneven template surface; insufficient template moisture; missed application of isolation agent. Preventive measures: Templates should be smooth and flat. Before installation, remove adhesive slurry thoroughly and apply full isolation agent. Moisten templates with water prior to pouring and tamping.

Pores. Cause: In areas with dense reinforcement, concrete becomes trapped or fails to be vibrated properly.

Preventive measures: For areas with dense reinforcement (e.g., beam-column joints), material should be cut in sections to reduce the thickness of layered vibration; vibrators must be used in accordance with regulations.

Gaps and slag inclusion. Cause: Construction joints were not properly cleaned and grouted, especially at column heads and stair slab bases.

Precautions: Re-inspect the stigmas, construction joints, and ladder plate feet before pouring, and remove debris, sand, and wood chips.

(2) Treatment of Concrete Defects

For pitted surfaces: First, rinse the surface thoroughly with clean water, then apply a 1:2 or 1:2.5 cement mortar to smooth it out.

Honeycomb and exposed reinforcement: First, remove the soft and weak concrete around the holes, then clean them with pressurized water or a wire

brush. For small honeycomb holes, apply 1:2 or 1:2.5 cement mortar to smooth and compact the surface. For large honeycomb holes with exposed reinforcement, treat them according to the hole size.

Holes: Remove the soft concrete of the column, clean it thoroughly with pressurized water or steel wire brush, and apply pure water epoxy cement slurry for sealing after formwork installation; for severe cracks, pipe-embedded pressure grouting may be employed.

Do not step on the steel bars, and ensure their arrangement meets the design specifications.

9.3 Quality Process Inspection System and Acceptance System

Establish the "Three-Inspection" system. After each process is completed, the work team shall first conduct a self-inspection, followed by a joint inspection and handover inspection organized by the site's chief engineer, involving construction personnel, quality inspectors, and technicians. For concealed works, the project management team and supervising engineer must review and approve the "Three-Inspection" system. Simultaneously, quality records and signatures for concealed work acceptance shall be documented and archived.

Establish a "three-level" inspection system. The company conducts a comprehensive quality inspection of the project once a month, the project department performs a comprehensive quality inspection once a week, and the work area carries out a comprehensive quality inspection once daily. During

inspections, relevant specifications and standards are strictly enforced. For any non-conformities identified during inspections, a non-conformity report is issued, with corrective actions required within a specified timeframe and follow-up verification conducted.

All concealed works must be signed off by the supervising engineer before proceeding to the next construction phase. Any work not signed off is prohibited. For concealed projects failing inspection by the supervising engineer, rework must be completed with self-inspection and re-inspection passing. The concealed work acceptance record shall then be updated, and a re-inspection report submitted to the resident supervising engineer. Upon approval, the signature approval procedures shall be promptly processed.

A work order issuance system shall be implemented for critical construction phases. For instance, prior to concrete pouring, the concrete construction supervisor must submit a written application to the project team for the issuance of a 'Concrete Pouring Order'. The project manager shall review and confirm that the conditions for pouring are met before issuing the order. Otherwise, the concrete construction machinery shall not be activated.

In strict compliance with the company's quality management standards, quality procedures, technical management documents, and provincial/municipal regulations on project completion acceptance filing, we systematically organize all concealed works acceptance records to ensure that construction logs, concealed works acceptance records, and quality evaluation

records for sub-items and sub-projects are complete, accurate, and reliable.

For any sub-project construction results that are covered by subsequent construction, concealed works acceptance shall be conducted. The results of concealed works acceptance must be recorded in the "Concealed Works Acceptance Record" and archived as documentation. The main contents are as shown in the table below.

Table 9.1 Inspection and Acceptance Content Table

Subsection	
reinforcement works	Specifications, quantity, location, and shape; joint type, position, and dimensions; quantity, location, specifications, and substitution status of embedded parts; detailed drawings of reinforcement supports
waterproofing work	Materials, thickness, and elongation rate of waterproofing layers for bathrooms, roofs, and basements
Water supply and drainage pipes	position, elevation, slope, pressure test, water test, welding, rust prevention, corrosion prevention
dark circuit	position, specifications, elevation, curvature, corrosion resistance, joints, cable voltage insulation test, ground wire, grounding resistance
else	Works that cannot be inspected upon completion, critical structural components, and concealed works with special requirements

Chapter 10: Safety and Civilized Construction Guarantee Measures Plan

10.1 Identification of Major Hazard Sources and Occupational Health & Safety Management Objectives

10.1.1 General Objectives of Work Safety

The overarching safety objective of this project is to achieve the "Five Zeroes" in major accidents (zero fatalities, zero severe injuries, zero collapses, zero poisonings, zero fires), while keeping the incidence of minor injuries below 10‰.

10.1.2 Safety Management Policy

Safety first, prevention foremost

10.1.3 Major Hazard Sources

Based on the project's design, overall construction plan, and actual site conditions, the following high-risk sub-projects are identified: operation and installation/dismantling of heavy machinery (tower cranes, elevators), on-site power supply, internal/external scaffolding safety, high-altitude work, and perimeter/opening protection. Specialized construction plans shall be developed with effective control measures, assigned to relevant departments and individuals, to ensure construction safety and actively prevent construction accidents.

10.2 Safety Production Management System and Training System

10.2.1 Safety Production Management System

(1) Safety Production Responsibility System

Establish comprehensive safety management systems with the work safety responsibility system as the core. These systems primarily include: work safety responsibility systems for all personnel at various levels; work safety target management systems; safety inspection systems; safety education systems; safety technical measures planning systems; safety briefing systems; special operation personnel management systems; safety acceptance systems; team safety activity systems; accident reporting and investigation systems; and safety reward and penalty systems. Work safety responsibility targets are decomposed layer by layer and assigned to individuals, with strict performance evaluations linked to economic incentives.

This project establishes a safety responsibility system with the project manager and technical director as the responsible persons, the construction foreman and team leaders as the main executors, the security and safety officers as the main supervisors, and the canteen and logistics as the guarantors.

(2) Safety Production Education and Training System

The program prioritizes four key components: safety awareness education, safety knowledge instruction, safety technology training, accident

prevention education, and legal compliance education. A three-tier safety education system is enforced, requiring new workers to complete at least 50 hours of safety training before commencing work, with written examination approval as a prerequisite. Regular training sessions are conducted to familiarize employees with national laws, regulations, and directives from higher authorities. Special emphasis is placed on safety education during high-altitude operations, rainy seasons, nighttime construction, and temporary electrical installations, helping workers understand the critical relationship between production and safety. The Quality and Safety Department must curate and select teaching materials and operational protocols based on work requirements and safety training resources, delivering targeted education that ensures practical effectiveness and real-world applicability.

The teaching method combines full-time (part-time) safety officer education and self-study, with on-site instruction supplemented by video recordings and broadcasts.

(3) Safety Production Incentive and Penalty System

The Regulations on Safety Production Incentives and Penalties for Institutional Projects shall reward and commend teams and individuals who have made outstanding achievements in safety production; penalize and educate underperforming departments, teams, and individuals; and impose corresponding penalties or hold accountable those responsible for accidents in accordance with relevant provisions.

Each safety inspection is scored, with economic penalties imposed on those responsible for items scoring below 75 points, and economic incentives given to those responsible for items scoring above 85 points.

Regularly organize safety knowledge competitions and provide rewards to outstanding performers.

Those responsible for failing to rectify or inadequately addressing issues identified during inspections shall be subject to corresponding financial penalties.

(4) Safety Production Inspection and Acceptance System

Inspection Schedule: The headquarters conducts biannual inspections, the company quarterly inspections, branch offices monthly inspections, and project departments twice monthly inspections. Additionally, inspections must be performed before all holidays. Inspections shall be chaired by production supervisors and project managers, with participation from safety technology, power, security, trade union, and other relevant departments.

Temporary inspections: including during construction peak periods, significant changes in organizational structure or personnel, around holidays, after work-related injuries or accidents, and inspections temporarily arranged by superiors.

All inspections shall be conducted in accordance with the "Construction Safety Inspection Standard" (JGJ59-99). For identified issues, rectification notices shall be issued with a specified deadline for correction, followed by

re-inspection. Construction sites or projects with significant safety hazards shall be ordered to suspend operations for rectification.

This project strictly follows the 'Acceptance Qualified Before Use' principle for construction safety inspections. All acceptance procedures must be documented and formally confirmed in writing; otherwise, they will be invalid. The items requiring acceptance for this project are listed in the table below:

Table 10.1 Safety Acceptance Form

Scope and Items of Acceptance	acceptance procedure
Personal protective equipment (PPE) such as scaffold poles, couplers, safety nets, safety helmets, safety belts, goggles, and insulated gloves	shall be accompanied by a certificate of factory release or proof of acceptance The project manager, technical director, and construction foreman jointly conduct the acceptance inspection.
Sectional and overall acceptance of scaffolding	The project manager or technical lead shall submit the erection plan and conduct inspection and acceptance with the engineering and safety authorities.
Small and medium-sized mechanical equipment	The project manager and foreman will lead the inspection and acceptance.
Installation and Acceptance of Tower Crane and Construction Elevator	The project manager and installation unit shall take the lead in conducting the inspection and acceptance together with relevant departments.

system of certification of work safety post

Safety officers and special operation personnel must be certified to work; reporting and statistics system of work safety accidents

Upon occurrence of a casualty incident, the injured personnel or the first person to discover the incident shall immediately report to the leadership. For incidents where the injured personnel are absent from work for more than one working day, the enterprise shall complete the casualty incident registration form and submit it promptly.

In the event of a serious injury or major casualty accident, the accident overview (including the number of casualties, time, location, and cause of the accident) must be immediately reported to the enterprise's competent authority, the industry safety management department, and the local public security department and the People's Procuratorate using a rapid method.

The investigation of the accident must adhere to the principle of "four no-passing": no passing until the cause of the accident is clear, no passing until the responsible person is punished, no passing until the responsible person and the masses are educated, and no passing until no preventive measures are taken.

10.2.2 Safety Production Education and Training System and Briefing System

The program prioritizes four key components: safety awareness education, safety knowledge instruction, safety technology training, accident prevention education, and legal compliance education. A three-tier safety education system is enforced, requiring new workers to complete at least 50 hours of safety training before commencing work, with written examination approval as a prerequisite. Regular training sessions are conducted to familiarize employees with national laws, regulations, and directives from higher authorities. Special emphasis is placed on safety education during high-altitude operations, rainy seasons, nighttime construction, and temporary electrical installations, helping workers understand the critical relationship between production and safety. The Quality and Safety Department must

curate and select teaching materials and operational protocols based on work requirements and safety training resources, delivering targeted education that ensures practical effectiveness and real-world applicability.

The teaching method combines full-time (part-time) safety officer education and self-study, with on-site instruction supplemented by video recordings and broadcasts.

Meanwhile, based on the process flow and construction methods specified in the construction organization design, prepare targeted and actionable safety technical briefings for sub-projects (sub-items), compile them into written documentation, and have both the briefing provider and recipient sign the agreement. This constitutes the sub-project/safety technical briefing.

10.3 Implementation Plan for Safety Technical Measures for Critical Hazard Sources

(1) The major hazard sources of this project are as follows

Operation, installation, and dismantling of large machinery (e.g., tower cranes, elevators);

Electricity for on-site construction;

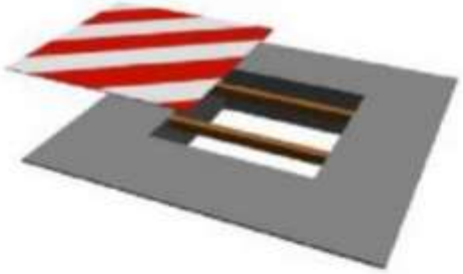
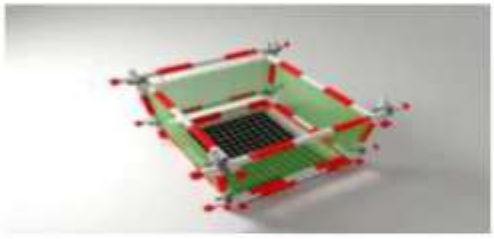
Internal and external scaffolding protection;

High-altitude work and edge and opening protection.

(2) Protective Measures

Table 10.2 Major Hazard Sources and Protective Measures

major hazard source	Schematic and Reference Figures	Maintenance Overview
Operation, Installation and Dismantling of Large Machinery (Tower Crane, Elevator)	 	Develop specialized construction plans for the use, installation, and dismantling of large-scale machinery, and strictly adhere to these plans during construction. Conduct three-level safety education for construction personnel, requiring certification for employment and designated supervisors. Enhance awareness of safety protection and self-protection, rigorously implement the acceptance system for large-scale machinery, perform regular maintenance and repairs, and prohibit machinery operation with faults.
on-site construction electricity		Develop a dedicated on-site temporary power supply plan and strictly implement it during construction. The installation of temporary power supply must be carried out by professional electricians; no unauthorized installation, removal, or wiring of power equipment or connection of power sources is permitted.

Internal and external scaffolding	 	Develop a specialized scaffolding construction plan and strictly implement it during construction. Use qualified materials, and provide three-level safety education to construction personnel when erecting or dismantling scaffolding, requiring certification for employment and designated supervisors. Strengthen supervision during construction and strictly enforce inspection and acceptance procedures.
High-altitude work and edge openings	 Pore  Protection of openings with side lengths between 0.5m and 1.5m opening protection	Develop a specialized construction plan and strictly implement it during construction. Strengthen supervision during construction, rigorously enforce inspection and acceptance procedures, and promptly rectify identified hazards.

10.4 Civilized Construction Guarantee Measures

(1) Construction Site Management

The construction site shall be equipped with a concrete floor to ensure a level and solid surface. However, areas prone to water accumulation, such as the mortar mixer shed, should be constructed with a cement floor and equipped with effective drainage measures.

The construction site shall have a circulating main road, which must remain regularly accessible without piling up components or materials. The road surface should be level and solid, with no large-scale water accumulation.

The construction site shall be equipped with proper drainage facilities to ensure unimpeded drainage.

Wastewater and slurry from construction operations must be channeled through drainage channels or pipelines to the site's centralized sedimentation tank for unified treatment, and must not be discharged indiscriminately or pollute waterways or roads outside the construction area.

The pipeline at the construction site must not exhibit any leakage, dripping, or large-scale water accumulation.

Smoking should be prohibited at construction sites to prevent hazards. Fixed smoking rooms or designated smoking areas should be established according to job categories. Smoking rooms must be located away from hazardous zones and equipped with necessary fire extinguishing equipment.

(2) General Construction Site Management

The reasonable layout of the whole construction site is the premise and key to do a good job of civilized construction, and strict management is the guarantee of civilized construction.

The construction plan is managed by the project manager, with implementation by relevant functional departments, and managed through a zoned responsibility system.

Provide and install a nameplate approved by the supervision company, displaying the project name, the contracting party, and the engineering supervision name. The text must be written by the qualified signboard artist. No other notices shall be displayed on the construction site except those approved by the supervision company.

The construction site is equipped with the 'Nine Signs and One Map' system in accordance with the company's CI standards.

Provide adequate lighting at temporary walls, fences, and hedges, as required by the government.

The site layout shall be designed in accordance with the master plan, covering: temporary office facilities, on-site restroom arrangements, material storage areas, steel bar processing zones, and drainage systems. Refer to the construction layout plan for details.

The construction site should strengthen the management of the site appearance, to achieve neat, clean, economical, safe, and strive for balanced

production.

The construction site must maintain a clean environment after work is completed. Construction waste should be centrally piled and promptly removed to ensure the site remains tidy.

All construction barriers shall maintain uniform color, be neatly aligned, and remain straight. A designated personnel shall conduct daily night patrols. Temporary barriers removed due to construction must be promptly restored, and any damaged barriers shall be replaced immediately. The surface shall be finished with two layers of mortar plaster or equivalent decorative finishes, followed by two coats of blended paint. The color, text, and pattern designs shall be selected or provided by our company, subject to approval by the supervising engineer.

(3) Temporary buildings

All temporary offices and meeting rooms on site were fully furnished to design specifications and painted to corporate identity standards.

The temporary facilities zone shall include the site's temporary roads, material and equipment storage areas, etc., which shall undergo site hardening. The contractor shall be responsible for the maintenance, repair, and upkeep throughout the entire construction process to meet all engineering requirements. Open drainage ditches shall be installed as required, and a car wash basin shall be provided at the main entrance.

The walls were constructed per the owner's specifications, with

repainting and signage installation in compliance with the company's Corporate Identity (CI) standards.

The entrance is clean and eye-catching, with distinctive visual design, and the 'nine signs and one map' are complete and intact.

The office area is maintained by designated personnel for public cleaning, with each office maintaining a rotating cleaning duty roster and conducting regular inspections.

A certain number of thermal insulation buckets and hot water supply points are set up at the construction site.

(4) Material storage area

All materials in the construction site or building must be neatly stored.

Construction materials and turnover materials shall be delivered in batches according to the construction schedule, and classified by material properties for storage with clear labeling. Ensure neat and stable stacking by specifications, maintaining alignment and straightness.

At construction sites, material storage shall implement necessary protective measures against rain, moisture, sunlight, fire, explosion, and damage based on material properties.

Valuable items, flammable, explosive, and toxic substances shall be promptly stored in designated warehouses under specialized management, with conspicuous labels affixed, and a strict material requisition and return procedure shall be established.

The material storage area is equipped with effective fire prevention measures, complete and functional firefighting facilities, and all construction personnel are proficient in the proper use of fire equipment.

Construction materials temporarily stored at the site must obtain approval from relevant authorities. Materials shall be neatly stacked without obstructing traffic or affecting urban aesthetics. When storing bulk materials, barriers shall be erected with a minimum height of 0.5 meters.

(5) Temporary living facilities

The construction site shall be equipped with sanitary restrooms, including flush toilets, which shall be managed by designated personnel.

Maintain cleanliness in both the building and construction site. No urination or defecation in public areas is permitted. Temporary toilets shall be installed every three floors in high-rise buildings to facilitate construction personnel within the building.

The canteen building and hygiene must comply with relevant sanitary requirements. For instance, kitchen staff must hold a valid health examination certificate issued by the health and epidemic prevention department, raw and cooked foods should be stored separately, canteen personnel must wear white work uniforms, and regular hygiene inspections of the canteen must be conducted.

The canteen should prominently display the hygiene responsibility system and assign it to specific individuals.

Construction site workers should have access to hygienically safe boiled water. There should be fixed water containers and designated personnel for management.

Household waste should be cleaned up promptly, transported centrally into containers, and managed by designated personnel.

Chapter 11 Construction Measures for Winter and Rainy Seasons

11.1 Winter Construction

(1) Preparations for Winter Construction

According to the winter construction tasks, make a good deployment for winter construction, and for the projects that are not suitable for winter construction, it is best to arrange the construction before or after winter.

The engineering technical measures and safety measures for winter construction are compiled.

Advance the winter material procurement plan to ensure timely supply by the Materials Department.

Establish and improve the management system of winter operation, such as: maintenance system, temperature measurement system, fire prevention system, storage and use system of chemical additives, anti-poison management system, etc.

Organize technical training for winter operations, including staff training for using compound admixtures and temperature recording personnel.

Concrete mixing stations should be enclosed and insulated, and construction machinery and equipment must be properly insulated for winter. Temporary structures, water channels, and gas pipelines should all be insulated and frost-proof before winter sets in.

For completed projects such as deep pits and foundations, protectiv e measures and winter insulation should be implemented in advance to prevent frost damage.

Always pay attention to the local meteorological station forecasts, s uch as cold waves, strong typhoons, and wind-induced temperature drop s, and take necessary measures promptly.

During the winter construction phase and the opening phase, a desi gnated person should be responsible for collecting and organizing meteo rological records as well as the actual measured outdoor minimum and maximum temperature records.

A comprehensive inspection of all preparatory work should be cond ucted before winter construction, and if necessary, another inspection sh ould be organized during the winter construction period.

(2) Key technical measures for winter construction

The calculation shows that the heating of concrete raw materials w ith hot water and antifreeze agent can meet all construction requirement s. During construction, the temperature of concrete leaving the machine should not be less than 10℃, and the temperature of concrete entering the mold should not be less than 5℃.

To minimize heat dissipation and temperature drop during concrete transportation, reduce the number of transfers, and shorten transit time, insulated hand carts are used. Concrete must not be dumped on the gro

und and should be poured directly into molds whenever possible.

During concrete foundation construction, external scaffolding with t arpaulin is used to block wind. A tarpaulin fence is erected around the work area, with the perimeter tightly secured and raised 1.5 meters ab ove the work surface to slow airflow and reduce concrete heat dissipati on. For exterior wall openings: before pouring concrete for beams and slabs, the surrounding openings are sealed with colored tarpaulin.

The roof slab concrete adopts the integrated heat storage method. After concrete pouring, insulation measures such as covering with plasti c sheeting and cotton felt are implemented for curing, with one layer o f plastic sheeting and one layer of cotton felt covering. Electric heaters are arranged below the construction surface, and the perimeter is seale d with tarpaulin.

The curing time is determined by the critical strength of concrete.

The concrete temperature should be measured in winter constructio n.

(3) Safety and Fire Prevention in Winter Construction

During winter construction, in addition to strictly complying with t he "Safety Technical Operation Specifications for Construction and Insta llation Workers" issued by the State Administration of Building Enginee ring and related regulations, the following tasks must also be complete d:

Ensure proper cold protection and labor safety measures for winter construction, prepare essential protective equipment and supplies in advance, and maintain adequate inventory.

During winter construction, it is crucial to emphasize wearing safety helmets when entering the site, safety belts for high-altitude work, and soft-soled anti-slip shoes.

Before and during construction, regular inspections of roads, access roads, scaffolding, and lifting platforms are required. Particular attention should be paid to timely patrols and cleaning after weather conditions such as wind, rain, or snow. Any identified safety hazards must be documented and addressed within a specified timeframe.

The gantry should be kept vertical and stable. Pulleys, guy wires, ground anchors, steel cables, and couplers should be inspected regularly, and any issues found should be addressed promptly.

The use of various chemical additives requires the establishment of storage, material requisition, and usage protocols to prevent errors that may lead to quality incidents or personal injuries, with particular emphasis on avoiding accidental ingestion and poisoning.

Before winter, conduct a comprehensive fire safety inspection of carpentry sheds, steel reinforcement sheds, material warehouses, oil depots, mixing stations, living quarters, and production areas to eliminate potential hazards and prevent fires.

Electrical wires must be installed in compliance with regulations an d not haphazardly strung. For overhead lines, steel conduits must be in stalled underground with proper insulation, and regular inspections shoul d be conducted to prevent electric shock injuries.

Regular inspections shall be conducted for mechanical equipment b efore and after winter. All electrical equipment must be equipped with grounding devices, braking devices, and residual current devices. Any n on-compliant items shall be promptly addressed with appropriate measur es, and a case shall be filed for rectification within a specified timefra me.

Water pumps, dump trucks, mixing stations, and exposed cold/hot water pipes must be equipped with anti-freeze insulation. After installati on, these systems should be drained promptly to prevent freezing. For t emporary water supply pipelines buried underground, if the installation depth falls below the permafrost threshold (0.8 meters), surface soil can be applied until the required depth is achieved.

It is strictly prohibited to store flammable or explosive materials n ear or beneath electrical welding operations, and welding work must no t be performed near or above such materials.

Open flames for heating are prohibited on-site. All fire-related acti vities must be supervised by designated personnel. Special personnel sh all be responsible for monitoring asphalt boiling operations. Fires must

be extinguished before leaving the premises after work hours.

Each dormitory should have a designated person responsible for fir e prevention, establish corresponding fire prevention teams and accounta bility systems to prevent fires.

Fire-fighting equipment should be inspected before and after winter construction. Fire buckets should be moved indoors and kept full of w ater regularly. Fire hydrants should be checked frequently for freezing r esistance.

A designated person shall be responsible for fire prevention, patrol supervision, inspection, and correction of violations on-site.

11.2 Construction during the rainy season

(1) Construction Measures Management During the Rainy Season

Before the rainy season construction, the relevant personnel should be carefully organized to analyze the rainy season construction producti on plan, and the rainy season construction measures should be prepared according to the rainy season construction project. The required materi als should be prepared before the rainy season construction.

Establish a flood control leadership group, formulate flood control plans and emergency response measures, which should cover both the c onstruction site and surrounding residential areas.

Dedicated on-duty personnel shall be assigned at night to ensure ro und-the-clock monitoring and maintain detailed duty logs. Additionally,

a weather forecaster shall be appointed to monitor and disseminate weat her updates.

The construction personnel should be trained for rainy season const ruction, and a comprehensive inspection should be organized for the pre paratory work at the construction site, including temporary facilities, te mporary power supply, and protection of mechanical equipment.

Inspect the drainage facilities at construction sites and production b ases, clear all drainage channels, and clean rainwater outlets to ensure unobstructed drainage during rainy days.

Drainage ditches shall be installed along both sides of the site roa ds to ensure non-slip, non-subsidence, and non-waterlogging conditions. Obstacles at the site shall be cleared to maintain unobstructed access to the roads. Within a designated area along both sides of the roads, no items shall be piled up, and the height of such piles shall not exceed 1.5m to ensure clear visibility and unimpeded road access.

Ensure that the base of scaffold uprights is secured with wooden o r concrete pads, and install sweep poles to maintain proper drainage an d prevent water accumulation. All access roads and ladders must be fitt ed with anti-slip strips. Before the rainy season, all units responsible fo r temporary facilities at construction sites and production bases—includi ng worker shelters, warehouses, canteens, mixing stations, and temporar y housing—must conduct comprehensive inspections and repairs to ensu

re that foundations, roads, and rooms are free from collapse, leakage, o r water accumulation.

Before the rainy season arrives, ensure lightning protection devices are installed on all tall structures and scaffolding. Conduct a thorough inspection of these devices prior to the rainy season to guarantee light ning safety.

Strengthen the determination of sand and gravel moisture content, a djust the water content of mix proportion.

During rainy season construction, lightning protection devices must be installed, all electromechanical equipment should be properly grounde d, and handheld electric tools must be equipped with leakage protection devices.

Electromechanical equipment must be fitted with rain covers to pre vent water leakage and subsequent damage. Conduct post-rain inspection s on such equipment.

Thoroughly implement rainwater interception and drainage measures, including digging drainage ditches around equipment foundations and r oad edges. Post-rainfall, conduct comprehensive inspections of equipmen t foundations, roads, and external scaffolding.

(2) Storage and stacking of raw materials

All cement shall be stored in warehouses. For warehouses without dedicated facilities, specialized sheds shall be constructed to ensure airti

ghtness and moisture-proofing. The floor shall be elevated for ventilatio n, and drainage ditches shall be installed around the perimeter to preve nt water accumulation.

The materials stacked on the first floor of the structure can be full y utilized.

Sufficient reserves of sand and stone materials must be ensured to guarantee the smooth progress of the project. Drainage outlets should b e provided around the site to prevent sludge infiltration.

Hollow bricks should be supported by wooden blocks at the botto m and covered with waterproof material at the top.

The template storage area must be compacted to prevent collapse a ccidents caused by ground subsidence.

The steel bars should be protected from rainwater to prevent corros ion.

Materials, equipment, and other supplies required during the rainy s eason, such as water pumps, suction hoses, straw bags, plastic sheets, a nd tarpaulins, should be prepared in advance by the materials departme nt and promptly organized for use. Water pumps and similar equipment should undergo maintenance beforehand.

Prior to the rainy season, conduct thorough inspections of on-site d istribution boxes, switchgear cabinets, and temporary cable supports. Rei nforce any areas requiring reinforcement and promptly replace missing c

overs, enclosures, or doors to ensure electrical safety.

Lightning protection measures should be implemented for scaffoldin g and gantry frames, or alternatively, the building's own lightning prote ction facilities may be utilized, provided that the grounding resistance meets the required standards.

During strong winds, reinforce large and tall structures to withstand the force.

Strengthen weather forecasting to prevent sudden heavy rainfall and arrange daily work rationally.

The temporary drainage pipes at the site should be dredged in adv ance and cleaned regularly.

On sunny days, assign dedicated personnel to open windows for ve ntilation to prevent excessive indoor humidity.

(3) Concrete construction

Concrete construction should be avoided whenever possible during rainy weather. Pouring concrete is strictly prohibited on days of heavy rain or torrential downpours. Newly poured concrete must be covered t o prevent rainwater erosion. Waterproof concrete construction is strictly forbidden on rainy days.

During the rainy season construction, the slump of concrete can be adjusted according to the actual conditions.

During the rainy season, the moisture content of sand and gravel s

hould be measured regularly, and the concrete mix proportion should be adjusted promptly, with strict control over the water-cement ratio. For concrete pouring in rainy weather, the slump should be reduced, and if necessary, the concrete grade may be increased by half a grade or one grade.

When pouring concrete for slabs and columns, the slump can be a ppropriately reduced. When beams and slabs are poured simultaneously, the pouring should proceed along the direction of the secondary beam. If construction is halted due to rain, the construction joint can be left on the secondary beam and slab to ensure the integrity of the main b eam.

(4) Reinforcement work

Reinforcing bars on-site should be elevated by 20cm above ground level to prevent water immersion and corrosion. Where feasible, the ba rs should be stacked on a steel reinforcement framework.

After rain, the steel bars should be treated for rust prevention as n eeded, and corroded ones must not be used in structural applications.

form work engineering

After removal, wooden formwork used in rainy weather should be laid flat to prevent deformation. Steel formwork should be cleaned pro mptly after dismantling and coated with release agent, which should be reapplied after heavy rain.

Concrete should be poured promptly after formwork assembly to pr event deformation caused by rain exposure. If concrete pouring cannot be completed immediately after formwork assembly and the formwork h as been exposed to rainwater, the formwork and supports must be re-in spected and reinforced prior to concrete placement.

When large formwork is installed, the ground must be solid and th e support must be secure.

(5) Scaffolding Engineering

Before the rainy season, conduct a comprehensive inspection of all scaffolding. The base of the upright poles must be securely fastened, a nd ground rods should be added. External scaffolding must be firmly at tached to the walls.

The scaffolding foundation should be monitored continuously. Any subsidence or deformation must be addressed immediately.