Analysis of construction technology of shear wall in house construction

Abstract: With the increase in economic development and urban construction, the development of the domestic construction industry has further accelerated. In building engineering, shear wall structures are commonly adopted, which can effectively ensure project efficiency. This article first analyzes the shear wall structure in building construction, then introduces the application of shear wall construction technology in house construction, including reinforcement construction technology, formwork construction technology, and concrete construction technology, and finally proposes key points for maintaining construction quality, hoping to provide effective reference for relevant personnel.

1 Introduction

With the development of the construction industry and the continuous expansion of construction scale, peoples emphasis on construction engineering technology is constantly increasing. Therefore, it is necessary to combine the performance requirements of buildings and reasonably adopt applicable construction technologies to ensure the safety and stability of construction projects, while improving the practicality of construction projects. Shear walls in construction engineering can help save construction costs and optimize construction quality, thus they have been widely applied [6-8]. Through in-depth research on shear wall construction technology, it can help optimize construction outcomes.

2 Analysis of shear wall structure in building construction

The application of shear walls in building construction mainly serves to effectively bear and conduct building loads while also demonstrating excellent isolation functions[1]. In the design of shear wall structures, reasonable arrangements should be made along the main axis [9,10]. Analyzing from the perspective of shear wall structure, due to its good bending ductility,

resistance to brittleness, and deformation ductility, in construction practice, the structural width and height can be appropriately expanded while reducing the actual thickness of the shear wall.

3 Analysis of construction technology application of shear wall in house construction

3.1 Project overview

A certain project is a residential building, including two underground levels and 24 above-ground floors, with a residents storage room set on the first basement level and a civil air defense basement on the second basement level. The main building structure of this project is a shear wall structure. In actual construction practice, it is necessary to comprehensively consider the actual conditions of each area, scientifically formulate construction plans, further optimize the overall construction quality of the shear walls, in order to enhance the stability of the entire building structure.

3.2 Line measurement

The construction of shear walls in this project requires proper layout and measurement work, with on-site construction personnel assisting formal construction through measurement. In practical operations, on-site construction personnel should first conduct layout and measurement according to the design drawings and the actual progress of house construction, standardizing the process. Utilizing advanced measurement tools to assist construction operations can improve the overall quality and accuracy of the project. During the layout and measurement of shear walls in the project, construction personnel can use instruments such as theodolites and total stations for measurement, reasonably selecting measurement equipment based on actual conditions. On-site construction personnel need to first determine the axis control network to assist in layout and measurement, then combine relevant technical standards and data information to verify and check the layout and measurement work to enhance its accuracy[2].

3.3 Reinforcing steel construction technology

In the construction of shear wall structures, it is necessary to strengthen quality management of the reinforcement engineering [11,14]. Before formal construction, it is essential to accurately

grasp all construction parameters and specific construction volumes. After preliminarily determining the specific construction parameters, analyze the relevant construction technical points.

First, in the entry of reinforcing steel, the material organization should take the lead in purchasing the required steel materials for the construction project, paying attention to reviewing the quality of materials and supplier qualifications during the material procurement process, scientifically testing the quality of reinforcing steel materials, and selecting high-performance and better-quality steel materials. Before organizing the entry of steel materials, it is necessary to conduct random inspections of various quality certificates and perform sampling tests. If the test results meet the construction performance standards, the steel materials can be directly organized for entry. From the perspective of frame column main bars, higher requirements apply, thus necessitating scientific analysis and verification of the flexural strength-to-torsional ratio and flexural-to-torsional ratio of frame column main bars. If different batches of steel materials are mixed for entry, accurate testing and control of carbon and manganese deviations within the steel should be conducted to ensure that all material performance indicators are within standard ranges.

Second, on-site arrangement of reinforcing bars. After the reinforcing bars officially enter the site, they need to be placed in designated areas according to material type and specifications, prohibiting mixed stacking of materials. At the same time, clear labels should be set for each specification and model. For the reinforcement bar storage area, it is necessary to reasonably set up I-beam racks to further process the raw reinforcing bar materials into semi-finished products, which must be stacked in rain shelters and labeled with material identification.

Third, the processing and treatment of reinforcing steel materials, due to the small area of the entire construction site, reinforcing steel materials are usually arranged in other sites. In foundation construction, reinforcing steel processing is carried out on non-working surfaces. During the construction of the main structure of the building project, it is necessary to reasonably organize and arrange reinforcing steel processing work, which can be achieved by using straightening machines to fully straighten the entire coil; meanwhile, using steel cutters to process grade three reinforcing steel for effective cutting; processing reinforcing steel materials through bending equipment; designing foundation material lists according to construction drawings and specifications, and orderly implementing reinforcing steel processing after specialized inspection.

Because some construction stages involve relatively complex reinforcement settings, it is necessary to do a good job in layout work, initially measuring and determining the dimensions and forms of reinforcing steel, and then organizing and implementing reinforcing steel processing and production in an orderly manner.

Fourth, implement hoisting and connection of reinforcing steel, and connect and fix the reinforcing steel at various joints of the building slab, columns, and beams using straight threads. At the same time, transport the reinforcing steel to the designated positions using a tower crane for securing and binding, and use square timber as a reinforcing steel pad. Note that in this process, reduce concentrated stacking to prevent floor slab collapse. For each construction node, implement stable binding of the reinforcement hoop to ensure that the entire shear wall structure meets the engineering stability standards [3].

Fifth, construction of protective layer. In the construction, the thickness of protective layer should be controlled as a key point, and the thickness of the whole protective layer should be adjusted with cement pads. The specifications of the uniform pads should be set to ensure that the quality standards are met.

3.4 Template construction technology

First, the construction of floor slabs, ladder forms, and beam forms generally employs multi-layer boards for formwork construction. In slab projects, 18mm thick plywood is selected as the construction formwork, with steel pipes serving as the foundation support. The overall specifications and models of the main trusses are effectively controlled, set at 5cm×8cm, while the specifications for secondary trusses are designed at 4cm×7cm.

Second, in the construction of wall formwork engineering, large aluminum formwork blocks are utilized, and for some special nodes in buildings, wooden formwork materials can be processed and made on-site to form construction formwork, setting up steel pipe scaffolding as the basic supporting structure. In the comprehensive construction of non-standard shear wall structures, various standardized formworks need to be installed on-site, paying attention to the tight connection between different panels to ensure the quality of material assembly and connection, improving the flatness of the entire formwork construction. Proper design and installation of internal and external formworks should ensure that the external formwork exceeds

the internal formwork by about 25cm to enhance the accuracy of the entire building formwork construction and prevent issues such as peeling and spalling of walls. In addition, optimizing the design and installation of internal and external formworks can improve the accuracy of formwork configuration. During formwork construction, orderly construction should be carried out in combination with the pouring of cast-in-place walls, enhancing the tight connection between the entire wall and the external formwork [4].

Third, in the construction of formwork for post-pour strips, bamboo plywood boards can be used as formwork materials, followed by placing wire mesh on the side. In house formwork construction, it is common to encounter issues with internal formwork and wall root errors, which can reduce the accuracy of formwork construction. To address this, relevant technical personnel should add short steel bars on the inner side of the formwork, which helps optimize formwork control and enhances the stability of the entire formwork. During the pouring construction of the formwork, the internal formwork should be fixed first, followed by pouring the formwork to improve the accuracy of the entire formwork construction.

Fourth, when constructing the formwork sections, it is necessary to first determine the spans of the beams and slabs. If the spans of both are no less than 4m, the formwork should be treated with arching; during the construction of the frame beams and frame columns, the thickness of the bamboo plywood sheets and other formwork materials should be reasonably controlled, not exceeding 12mm; ensure proper setting and conversion of beam formwork, accurately calculate the formwork and support spacing, and add a multi-layer formwork with an additional 15mm thickness. In this project, the construction of stair platform and slab formwork is carried out entirely using bamboo plywood sheets, optimizing the design of top supports to convert them into adjustable steel pipes. During formwork construction, it is also essential to strictly follow the technical standards listed in Table 1 for formwork removal procedures.

Table 1 Template removal parameters

Location of template	span /m	Demolding strength requirements

structure		
Suspension components		It should not be less than 100% of the design strength
Arches, shells and beams	Not exceeding 8	It should not be less than 75% of the design strength and 100% of the design strength
board	Above 2 but below 8 Above 8	It should not be less than 75% of the design strength and 100% of the design strength

3.5 Concrete construction technology

In this construction project, the main focus is on shear wall construction techniques, which requires accurately grasping the key points of construction technology [7,11,14]. During concrete construction, walls should be poured in an order from outside to inside, branching out and advancing parallelly along the axis, while different groups take care of the width of the cross walls on both sides. Before pouring concrete for the walls, concrete should be poured first at a thickness of 5cm at the bottom joint, maintaining layered and segmented pouring. The pouring height should be determined based on the density of the reinforcing bars and the structural characteristics of the project; the first layer pouring height must not exceed 50cm, and subsequent layers must not exceed 1m. Concrete delivery points should be distributed throughout the wall. If the wall height is less than 3m, concrete can be poured directly below the top of the wall; if the wall height exceeds 3m, segmented pouring using a chute and side formwork chutes is required. Each segments pouring height should be controlled to less than 2m, and after completing each segment, the door openings should be sealed tightly. During wall pouring, pre-set pouring ports should be installed at appropriate fixed locations to facilitate concrete pouring construction, and additional chutes and chutes should be added for material delivery. Exterior wall pouring can be performed in segments and layers, rotating and converging cyclically until the entire exterior wall pouring construction is completed. When pouring at the openings, to improve the uniformity and symmetry of the pouring heights at both ends of the openings, concrete should be poured from about 30cm away from the edge of the openingSynchronous vibration construction at both ends

can prevent deformation problems in the whole cave entrance. The opening on the lower side of the large cave entrance can be reasonably added, and concrete can be added in time to fully compact the vibration [5].

First, the concrete construction technology in this project is mainly ready-mixed concrete construction. Before the formal construction begins, it is necessary to actively contact with suppliers and carry out trial mixing treatment for concrete materials in the project to improve the continuity of concrete supply and prevent aggravating the adverse effects of construction.

Second, when pouring concrete, it is necessary to do a good job of checking and accepting all hidden works to improve the quality of hidden works.

Third, the construction of concrete pouring of engineering foundation slab requires scientific division of post-pour strips. When performing concrete construction on construction joints and reserved parts, it is necessary to strictly follow the requirements of standards and specifications to make the surface and axis of the whole construction joint perpendicular to each other.

Fourth, do a good job of layered feeding. In the feeding construction, combine the use of layout rods to reasonably control the quality of concrete pouring, and use vibration rods to comprehensively vibrate the project. In the concrete pouring construction of the main structure and walls, it is necessary to reasonably control the thickness of layered concrete pouring, which can be limited to around 500mm. After vibrating and pouring the first layer of concrete, it is necessary to check that the material meets the standard compressive strength criteria before conducting secondary vibration construction before the initial setting of concrete. When fixing and connecting wall formwork and floor slabs, key attention needs to be paid to addressing leakage issues during pouring construction to improve floor slab stability. To prevent such problems, construction technicians need to add a certain amount of mortar and cement materials between the formwork and floor slabs.

Fifth, reasonable concrete test blocks should be reserved at the site of this project, and the anti-seepage and anti-compression tests of materials should be carried out to accurately judge whether the concrete pouring construction meets the expected quality standards.

Sixth, after the completion of concrete pouring construction, it is necessary to carry out proper curing treatment for the entire concrete structure. For example, after the initial concrete pouring of the slab section, watering curing can be carried out simultaneously covering the slab

concrete structure reasonably with burlap cloth. During the curing process of the project, it is essential to maintain good moisture on the surface of the slab concrete, setting the curing period to 7 days. In construction, it is important to note that if the material used in the project is waterproof concrete, the curing time should be appropriately extended, typically maintained around 14 days.

4 Key points of construction quality maintenance

In order to better maintain the quality of the shear wall engineering, the following operations should be reasonably controlled in the actual construction process [12,15].

First, select high-quality construction materials. The quality of base materials directly affects the quality of the shear wall structure of the building. Therefore, before various construction materials officially enter the site, a comprehensive inspection of the specific factory certificates and quality qualification certificates of the materials is required. Before starting each sub-project, the quality and performance of the construction materials should be comprehensively tested.

Second, continuously innovate technical solutions for transitional layer construction. Combining seismic disaster impact analysis, shear wall structures in buildings typically need to withstand high pressures. Under load influence, the overall load-bearing capacity of transitional layer shear walls will show a continuous decreasing trend. Based on this situation analysis, in construction practice, it is necessary to continuously optimize the transitional layer construction plan. In the design and construction of structural columns, emphasis should be placed on enhancing the seismic shear force transmission performance of the entire transitional layer and improving its flexibility.

Third, accurately grasp various construction precautions. For example, in the construction of reinforced concrete structures with cast-in-place sections, if the edge columns and edge beams are flush, the longitudinal reinforcement of the beam should penetrate through the vertical reinforcement of the column. This operation will further increase the external concrete thickness of the beam, thus requiring an appropriate reduction in the width of the beams stirrups to ensure that the stirrup corners and longitudinal reinforcement at both ends of the beam are fully adhered. However, in actual construction practices, the width of the beams stirrups is often not reduced, leading to a lack of longitudinal reinforcement assistance on the outside of the stirrups, which

prevents proper correction of the beams longitudinal reinforcement and stirrup connections, thereby reducing the stability of the frames edge beams. In reinforced concrete welding construction, issues such as uneven welding can easily occur due to welding head problems; therefore, it is necessary to maintain standard verticality of the total axis line and joint cross-section of the reinforcement, thoroughly trimming the weld joints with gas cutting to clean the surface and ensure uniform force application, thereby improving welding quality.

5 Conclusion

In summary, shear wall structures are widely welcomed and extensively applied in the construction engineering field due to their excellent seismic performance, load-bearing capacity, and stiffness characteristics. Shear wall structures directly impact the overall quality of a project, and supported by advanced technology, they have promoted further development of shear wall technology. At the same time, the requirements for the quality of shear wall construction continue to rise, necessitating continued research into shear wall construction techniques to support continuous innovation and development. It is also essential to implement comprehensive control over all construction phases, focusing on detail management to optimize the quality of shear wall construction.

References

[1] WeiChen. Research on Construction Technology of Shear Wall in Housing Construction [J]. Design of Nonferrous Metals, 2022,49(4):41-43,52.

[2] YongchaoZhou. Analysis of Construction Technology for Main Structures of Frame and Shear Wall Structures in Building Engineering [J]. Engineering Construction and Design, 2022(21):168-170.

[3] ShizhuTan. Research on Construction Technology of Frame and Shear Wall Structure of House Building Engineering [J]. Engineering Technology Research, 2021,6(15):57-58.

[4] WeijiangCao. Research on the Practice of Frame Shear Wall Structure echnology in House Construction [J]. Residential and Real Estate, 2020(23):167-168.

[5] JingSun. Application of Frame Shear Wall Structure Technology in Building Construction [J]. Chinese and Foreign Entrepreneurs, 2019(10):119.

[6] GUO, Y. L., & ZHU, J. S. (2020). Research progress of shear walls: types and design methods. *Engineering Mechanics*, *37*(6), 19-33.

[7] Lukacs, I., Björnfot, A., & Tomasi, R. (2019). Strength and stiffness of cross-laminated timber (CLT) shear walls: State-of-the-art of analytical approaches. Engineering Structures, 178,

136-147.

[8] Wang, W., Ren, Y., Lu, Z., Song, J., Han, B., & Zhou, Y. (2019). Experimental study of the hysteretic behaviour of corrugated steel plate shear walls and steel plate reinforced concrete composite shear walls. *Journal of Constructional Steel Research*, *160*, 136-152.

[9] Zhu, L., Kong, L., & Zhang, C. (2020). Numerical study on hysteretic behaviour of horizontal-connection and energy-dissipation structures developed for prefabricated shear walls. *Applied Sciences*, *10*(4), 1240.

[10] Kumawat , K., Gupta, T., Shekhawat, R. S., & Agrawal, Y. (2024). Seismic Response of Stiffness Irregularity at Ground Floor with and without Shear Walls. *Journal of Scientific Research and Reports*, *30*(1), 12–24. https://doi.org/10.9734/jsrr/2024/v30i11819

[11] Guan, M., Hang, X., Wang, M., Zhao, H., Liang, Q. Q., & Wang, Y. (2024). Development and implementation of shear wall finite element in OpenSees. *Engineering Structures*, *304*, 117639.

[12] Gonzaga, R. L., & Escober, M. T. (2024). Seismic Performance of High Rise Flat Slab Structure with Reinforced Concrete Outriggers in Seismically Active Regions: A Case Study. *Current Journal of Applied Science and Technology*, *43*(10), 36–50. https://doi.org/10.9734/cjast/2024/v43i104435

[13] Hoult, R., Goldsworthy, H., &Lumantarna, E. (2019). Fragility functions for RC shear wall buildings in Australia. *Earthquake Spectra*, *35*(1), 333-360.

[14] Li, H. (2024). Comprehensive Review on Valuation Method for Bill of Quantities in Prefabricated Shear Wall Structures Using BIM. *Journal of Engineering Research and Reports*, *26*(10), 136–146. https://doi.org/10.9734/jerr/2024/v26i101295

[15] Jeon, S. H., & Park, J. H. (2020). Seismic Fragility of Ordinary Reinforced Concrete Shear Walls with Coupling Beams Designed Using a Performance-Based Procedure. *Applied Sciences*, *10*(12), 4075.