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COLUMN STRUCTURAL WORK METHODS IN MULTI-STORY RESIDENTIAL BUILDING CONSTRUCTION

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Abstract: This study investigates the column structural work methods employed in the construction of a 4-story residential building in Pondok Indah, South Jakarta, focusing on preparation, execution, and quality control processes. Utilizing a qualitative observational approach during a professional internship, the research documents reinforcement fabrication, formwork installation, concrete placement, formwork removal, and curing practices. Key findings highlight the use of 16-25mm deformed bars for longitudinal reinforcement, plywood formwork with steel supports, and a 30 MPa concrete mix, with systematic procedures ensuring dimensional accuracy and structural integrity. Quality control measures, including plumbness checks, slump testing, and compressive strength verification, were critical to achieving compliance with project specifications. The study underscores the importance of precise reinforcement assembly, controlled concrete placement, and rigorous quality protocols in balancing theoretical design requirements with practical implementation. The methods demonstrated efficiency and quality, aligning with established standards while adapting to site-specific conditions. Recommendations for future projects include detailed planning for reinforcement, investment in quality formwork, comprehensive quality control, and worker training to enhance efficiency and durability. This research provides practical insights for civil engineers aiming to optimize column construction in multi-story residential buildings.

Keywords: Column construction, reinforced concrete, formwork installation, quality control, multi-story residential building, reinforcement fabrication, concrete placement.

INTRODUCTION

Columns are vertical structural elements that play a crucial role in supporting building loads. They are essential components in the structural system of buildings, working alongside beams and foundations to ensure structural integrity and stability. In column design, engineers can choose from various cross-section shapes, with circular and rectangular being the most common options.

While columns with circular cross-sections demonstrate superior load-bearing performance compared to those with rectangular cross-sections, the construction industry often favors rectangular columns due to their ease of implementation. This practical consideration highlights the balance between theoretical performance and construction practicality that engineers must navigate in real-world projects.

The construction of residential buildings, particularly multi-story structures, requires careful planning and execution of column work to ensure structural stability and safety. The methods employed in column construction significantly impact the overall quality,

durability, and timeline of building projects. Understanding these methods is essential for civil engineering professionals to effectively manage construction projects.

This study examines the column structural work methods implemented in a 4-story residential building project in Pondok Indah, South Jakarta. The research focuses on the preparation, execution, and quality control processes involved in column construction, providing valuable insights for civil engineering practitioners and students.

Theoretical Foundation of Column Structures

Columns are designed to primarily resist compressive forces while also handling moments and shear forces in certain structural configurations. According to structural engineering principles, the load-bearing capacity of columns depends on several factors including cross-sectional shape, material properties, reinforcement details, and effective length (Nawy, 2008).

The behavior of reinforced concrete columns under various loading conditions has been extensively studied. Research by Mander et al. (1988) established models for confined concrete behavior in columns, which remain fundamental to modern column design approaches. These models demonstrate how proper confinement through transverse reinforcement significantly enhances column strength and ductility.

Column Construction Methods

Previous studies have documented various methods for column construction in building projects. Peurifoy and Oberlender (2011) outlined standard procedures for reinforcement fabrication, formwork installation, concrete placement, and formwork removal in column construction. Their work emphasized the importance of proper sequencing and quality control in achieving structural integrity.

Research by Tam et al. (2005) compared different formwork systems for concrete columns, evaluating factors such as construction speed, cost-effectiveness, and quality outcomes. Their findings indicated that the selection of appropriate formwork systems significantly impacts project efficiency and structural quality.

Quality Control in Column Construction

Quality control measures in column construction have been addressed by several researchers. According to Oberlender (2000), critical inspection points include reinforcement placement, formwork alignment, concrete mix design, concrete placement techniques, and curing procedures. Proper implementation of these quality control measures is essential for ensuring column structural integrity.

Recent studies by Aslani and Nejadi (2012) have focused on the impact of construction practices on the durability of reinforced concrete columns, highlighting the relationship between construction methods and long-term structural performance.

RESEARCH METHOD

This research employed a qualitative observational approach to study column structural work methods in a 4-story residential building project in Pondok Indah, South Jakarta. The study was conducted during a professional internship at PT. HY Desain Build, allowing for direct observation and documentation of construction practices.

Data Collection

Data collection methods included:

1. Direct field observation of column construction processes

2. Documentation review of project specifications and structural drawings
3. Interviews with site engineers and construction workers
4. Photographic documentation of construction sequences

The observation focused specifically on the following aspects of column construction:

1. Preparation work for column construction
2. Column reinforcement fabrication processes
3. Formwork installation techniques
4. Column alignment and verification procedures
5. Concrete placement methods
6. Formwork removal processes
7. Quality control measures

Data Analysis

The collected data was analyzed through a systematic process of categorization and comparison with established construction standards and best practices. The analysis focused on identifying the specific methods employed, evaluating their effectiveness, and determining critical factors affecting construction quality and efficiency.

RESULT AND DISCUSSION

Column Reinforcement Fabrication

The column reinforcement fabrication process began with the preparation of reinforcement bars according to structural drawings. The main longitudinal reinforcement consisted of deformed bars with diameters ranging from 16mm to 25mm, while transverse reinforcement utilized 10mm diameter bars.

The fabrication process followed these sequential steps:

1. Cutting of reinforcement bars to specified lengths
2. Bending of bars to create hooks and stirrups
3. Assembly of longitudinal and transverse reinforcement
4. Installation of spacers to ensure proper concrete cover

Quality control during fabrication focused on ensuring accurate bar dimensions, proper bending radii, and correct spacing of transverse reinforcement. The fabricated reinforcement cages were inspected before installation to verify compliance with structural drawings.

Column Formwork Installation

The project utilized plywood formwork with steel frame supports for column construction. The formwork installation process involved:

1. Marking of column positions according to layout drawings
2. Assembly of formwork panels
3. Application of release agent to interior formwork surfaces
4. Installation of formwork around reinforcement cages
5. Securing formwork with clamps and braces
6. Verification of formwork alignment and dimensions

The formwork system provided dimensional stability while allowing for easy assembly and disassembly. Particular attention was paid to ensuring vertical alignment and plumbness of the formwork, as these factors directly impact the structural integrity and aesthetic appearance of the finished columns.

Column Concrete Placement

Concrete placement for columns followed a systematic approach to ensure proper consolidation and minimize segregation. The concrete mix design specified a compressive strength of 30 MPa with appropriate workability for column applications.

The concrete placement process included:

1. Pre-placement inspection of reinforcement and formwork
2. Concrete delivery and slump testing
3. Placement of concrete in layers of approximately 50cm
4. Vibration of each layer to ensure proper consolidation
5. Continuous monitoring of formwork stability during placement

The concrete placement rate was controlled to prevent excessive pressure on the formwork while ensuring proper consolidation. Vibration techniques were carefully implemented to avoid reinforcement displacement and ensure complete filling of the formwork.

Formwork Removal and Curing

Formwork removal was scheduled based on concrete strength development, typically occurring 24-48 hours after placement, depending on ambient temperature conditions. The removal process followed these steps:

1. Loosening of clamps and braces
2. Careful removal of formwork panels
3. Immediate inspection of concrete surfaces
4. Application of curing compound to exposed concrete surfaces

Following formwork removal, columns were subjected to a curing regimen involving regular water spraying and covering with plastic sheets to maintain appropriate moisture conditions for optimal strength development.

Quality Control Measures

Quality control measures implemented throughout the column construction process included:

1. Dimensional verification before and after concrete placement
2. Plumbness checks using spirit levels and plumb bobs
3. Concrete slump testing before placement
4. Concrete cube sampling for compressive strength testing
5. Visual inspection of concrete surfaces after formwork removal

These measures ensured compliance with project specifications and structural requirements, contributing to the overall quality and durability of the column structures.

CONCLUSION

The study of column structural work methods in the 4-story residential building project in Pondok Indah, South Jakarta, revealed a systematic approach to column construction that balances theoretical requirements with practical implementation considerations.

The key findings of this research include:

1. The importance of proper reinforcement fabrication and assembly in ensuring structural integrity
2. The critical role of formwork quality and alignment in achieving dimensional accuracy

3. The significance of controlled concrete placement and vibration techniques in preventing defects
4. The value of comprehensive quality control measures throughout the construction process

These findings highlight the multifaceted nature of column construction, where success depends on the integration of proper materials, skilled workmanship, and rigorous quality control.

The methods observed in this project align with established construction practices while incorporating project-specific adaptations to address particular site conditions and structural requirements. The systematic approach to column construction contributed significantly to the structural quality and construction efficiency of the project.

For future residential building projects, it is recommended to:

1. Implement detailed planning for reinforcement fabrication to minimize on-site adjustments
2. Invest in quality formwork systems that provide dimensional stability and ease of use
3. Develop comprehensive quality control protocols specific to column construction
4. Provide specialized training for workers involved in column construction activities

These recommendations can enhance construction efficiency while ensuring structural quality in residential building projects.

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