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Optimization of Planning Drawings as a Technical Language in Field Operations for Construction Work

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Gamaliel K Jarek[1], Mualifah Elisha Hosana[2]
[1]Lecturers, Student
Department of Civil Engineering, Faculty of Engineering
[1] Doktor Nugroho University, Magetan, [2]GeanMT
Email : gamalielkjarek@udn.ac.id, geanmt@gmail.com

ABSTRACT

Gamaliel K. Jarek, Mualifah Elisha Hosana.(2025). Optimization of Planning Drawings as a Technical Language in Field Operations for Construction Work.

This study examines the function of planning drawings as a medium of technical communication in field operations on construction projects, as well as the challenges encountered in their practical application. A qualitative approach was employed through a case study of a high-rise building project in Jakarta, involving designers, supervisors, and field workers. Data were collected through in-depth interviews, direct field observations, and analysis of planning drawing documents. The findings indicate that clear and comprehensive planning drawings reduce technical errors and enhance work efficiency; however, issues such as misinterpretation and limited worker competency remain prevalent. Optimization efforts may include standardizing symbols, improving drawing details, and utilizing technologies such as Building Information Modeling (BIM) to strengthen technical comprehension. Training programs for field workers are also crucial in minimizing errors and increasing productivity. This study recommends that construction companies invest in improving the quality of planning drawings and providing adequate worker training to ensure smoother project execution.

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I. INTRODUCTION

Construction work is a multidisciplinary activity that involves various actors with different technical competencies, requiring highly precise coordination and communication. Each stakeholder—including designers, supervisors, and field workers—holds a strategic role in determining project success. In this regard, effective technical communication becomes a fundamental requirement because it minimizes errors and ensures a shared understanding of objectives, procedures, and implementation standards. As Gorse and Emmitt (2009) argue, *"effective construction communication is central to achieving coordinated project performance."*

The significance of technical communication becomes more evident when linked to the function of planning drawings as the primary medium for transmitting design concepts to field implementation. Such drawings are not merely technical illustrations; they serve as a communicative tool that translates architectural and engineering ideas into operational guidelines. Through these drawings, information related to dimensions, structural systems, materials, and other technical specifications is presented systematically. Tilley (2005) highlights this by stating that *"technical drawings serve as structured information systems that guide construction execution with clarity."*

However, the effectiveness of planning drawings is often hindered by various technical and non-technical challenges, including ambiguous visual elements, inconsistent symbols, incomplete information, or inadequate graphic quality. These issues may lead to misinterpretation and deviations during implementation. Çelik and Artan (2018) note that *"misinterpretation in construction drawings often results from inconsistencies that could have been prevented through proper documentation standards."*

Drawings that lack clarity or adequate detail can adversely affect construction quality, generate additional corrective costs, and cause delays. Blurred visuals or the use of non-standard notation frequently lead to differing interpretations, especially among field workers who may be unfamiliar with such formats. This is consistent with Knipe's (2012) assertion that *"unclear design documentation is a major contributor to on-site decision errors."*

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Moreover, the absence of supporting information—such as material specifications or construction details—may force workers to make assumption-based decisions, which carry significant risks. Illingworth (2000) emphasizes that *"assumption-based decisions in construction frequently lead to costly rework and safety issues."* These consequences demonstrate that ambiguity in drawings is not merely a graphical problem but a systemic issue within the construction workflow.

O'Connor and Moffatt (2017) underline that *"technical communication failures in construction projects often originate from visual representations that are not fully understood by key stakeholders."* This highlights the need to optimize planning drawings as effective communication tools. The adoption of technologies such as Building Information Modeling (BIM) and Computer-Aided Design (CAD) facilitates the creation of more accurate and interactive drawings that can be visualized in three-dimensional formats.

Digital technologies also support early detection of design conflicts and reduce the likelihood of discrepancies in the field. These efforts must be accompanied by standardization of symbols, notation, and drawing conventions, along with comprehensive legends to improve document readability. Eastman et al. (2011) affirm that *"standardized digital modeling significantly enhances the reliability of construction documentation."*

Beyond technology, strengthening human resource capacity is essential to improving technical communication. Systematic training for field personnel in interpreting technical drawings is necessary to bridge competency gaps. Abdullah and Edge (2020) maintain that *"capacity building in drawing literacy equips construction personnel to interpret design intent more accurately."*

Thus, detailed, accurate, and standardized planning drawings form a foundational element for ensuring efficient and error-free construction processes. Ambiguities in visual representation not only affect technical execution but also influence project costs, safety, and schedule adherence. As Sacks et al. (2018) contend, *"clarity in design communication is inseparable from project performance."* Enhancing the quality of planning drawings, leveraging digital technologies, and strengthening human competencies are therefore strategic measures essential to minimizing risks and achieving successful project outcomes.

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II. RESEARCH METHOD

This study employed a qualitative approach with a case study design to examine the role of planning drawings as a technical language in field communication within construction projects. The case study was conducted on a high-rise building project in Jakarta due to the intensive coordination required between design and on-site implementation. The study involved 15 informants consisting of designers, supervisors, and field workers, selected through purposive sampling based on their direct involvement in using planning drawings. Data were collected through in-depth interviews, field observations, and document analysis, including design drawings, revised drawings, and coordination records.

The collected data were analyzed using thematic analysis to identify patterns and themes related to interpretation challenges, the use of technologies such as CAD and BIM, and strategies for optimizing the comprehension of planning drawings. The analysis process included data transcription, open coding, categorization of themes, and the interpretation of relationships between themes, allowing for a comprehensive understanding of technical communication practices in the field.

To ensure data validity, the study employed source triangulation and methodological triangulation by comparing findings from designers, supervisors, and field workers, as well as corroborating data from interviews, observations, and technical documents. Validation was further strengthened through member checking, in which interpretations were confirmed with the informants, and peer debriefing with construction experts to assess analytical accuracy. These combined procedures ensured that the findings were both credible and scientifically reliable.

III. FINDINGS AND DISCUSSION

3.1 Findings

The results of the study indicate that planning drawings play a strategic role as a medium of technical communication in construction projects. Field data show that drawings that are clearly presented, comprehensive, and consistent significantly reduce implementation errors and improve time and cost efficiency. Informants—including designers, supervisors, and field workers—consistently emphasized that the accuracy of planning drawings directly influences the speed, precision, and effectiveness of on-site operations. The study also identified several challenges, such as unclear symbols, inconsistent notations, and limited drawing literacy among some field workers. These factors were found to be the primary causes of misinterpretation and deviations from the intended design. Furthermore, the incorporation of technologies such as

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Building Information Modeling (BIM), along with capacity-building efforts through technical training, was shown to enhance workers' understanding of construction drawings and reduce the likelihood of technical errors.

3.2 Discussion

The findings reinforce the notion that planning drawings function not merely as visual representations of design concepts but as a "technical language" that aligns the understanding of all parties involved in construction activities. The consistency of visual elements—such as symbols, dimensions, and annotations—plays a crucial role in ensuring accurate interpretation. When drawings are detailed and well-structured, construction workflows can proceed more systematically because workers possess clear operational references. Conversely, ambiguous or insufficiently detailed drawings often lead to misinterpretations, resulting in rework, increased costs, and project delays. These issues are compounded by the low level of technical literacy among some field workers who are not fully trained in reading engineering drawings.

The discussion further indicates that the use of digital technologies, particularly BIM, provides a more comprehensive and accessible representation of design information compared to conventional two-dimensional drawings. BIM's three-dimensional visualization capabilities support field personnel in understanding spatial relationships among structural elements and identifying potential design conflicts at an early stage. Technical training for field workers also emerged as a key factor in improving drawing interpretation accuracy. Thus, optimizing planning drawings through symbol standardization, digital integration, and human resource development represents a strategic approach to strengthening technical communication and enhancing the overall quality of construction execution.

3.3 Implications of the Study

The findings of this research carry several important implications for construction practice, particularly regarding the need to strengthen technical communication through improved planning drawings. First, the results highlight the urgency of producing standardized and communicative planning drawings as a foundational element for on-site coordination. Standardized symbols, clear notation, and consistent detailing are essential to ensuring that field workers can accurately interpret design instructions. Accordingly, construction companies should develop internal guidelines or Standard Operating Procedures (SOPs) for the creation, review, and verification of planning drawings.

Second, the study emphasizes the importance of enhancing human resource competencies, especially among field workers who serve as primary users of construction

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drawings. Regular training on reading drawings, understanding technical symbols, and recognizing construction details can help reduce the knowledge gap between designers and implementers. Such capacity-building efforts not only improve work accuracy but also contribute to site safety by ensuring that workers have a correct understanding of technical requirements.

Third, the findings underscore the growing necessity of integrating digital technologies, particularly BIM, into design coordination processes. BIM provides comprehensive three-dimensional visualizations and real-time data updates, enabling all stakeholders to better understand the design as a unified system. The adoption of such technologies not only enhances drawing quality but also accelerates the identification of potential issues prior to construction.

Overall, the study demonstrates that improving drawing quality, strengthening workforce competencies, and adopting digital technologies are strategic measures that construction companies must prioritize to minimize errors, increase efficiency, and support the successful completion of projects.

IV. CONCLUSION

4.1 Conclusion

This study concludes that planning drawings play a fundamental role as technical communication instruments in construction projects. Clear, detailed, and consistent drawings were found to reduce technical errors and improve coordination among project stakeholders significantly. All informants affirmed that the quality of planning drawings directly influences the speed, precision, and overall fluidity of construction operations. However, the study also identified several obstacles, including misinterpretation, non-standardized symbols, and limited drawing literacy among field workers. These issues contribute to communication breakdowns, delays, cost overruns, and the risk of rework. Therefore, optimizing planning drawings through symbol standardization, enhanced detailing, and the use of digital technologies such as BIM represents a strategic effort to strengthen technical communication and improve construction performance.

4.2 Suggestions

1. **Standardization and Quality Improvement of Planning Drawings**

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Project managers should ensure that planning drawings meet adequate technical standards, including consistent use of symbols, clear annotations, and complete detailing. Such consistency is essential to reduce misinterpretation and to support effective communication among designers, supervisors, and field workers.

2. **Technical Training for Field Workers**

   Training programs focused on reading and interpreting technical drawings are needed to improve field workers' competencies, particularly for those without formal technical backgrounds. Enhanced drawing literacy will help minimize execution errors and increase overall work efficiency.

4.3 Recommendations

Construction companies are encouraged to allocate resources to improve the quality of planning drawings and strengthen technical communication at project sites. The adoption of digital technologies—especially BIM—offers significant advantages due to its realistic three-dimensional visualization and ease of use for all project participants. In addition, companies should implement continuous training initiatives on drawing interpretation, symbol usage, and digital construction technologies. These efforts will help reduce technical errors, enhance productivity, and optimize project costs, ultimately contributing to the successful completion of construction projects.

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