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REQUIREMENTS FOR THE PREPARATION OF DESIGN DOCUMENTATION BASED ON BUILDING INFORMATION MODELING (BIM) TECHNOLOGY

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Abstract:

The article examines the requirements for preparing design documentation using Building Information Modeling (BIM) technology in Uzbekistan's construction industry. BIM optimizes design processes, automates the creation of drawings and documentation, and enhances coordination among project participants. Special attention is paid to the methods of implementing BIM, including the development of 3D models, adherence to standards, classification systems, and building parameter analysis. The main results of BIM implementation are presented, and the existing challenges and future prospects of this technology are discussed. A comprehensive analysis demonstrated that the successful adoption of BIM can significantly improve construction project management, drive industry digitalization, and increase its competitiveness at the international level.

Keywords: *Building Information Modeling (BIM), design documentation, 3D modeling, standards, coordination, digitalization, construction, automation, optimization, building life cycle.*

INTRODUCTION

In the Republic of Uzbekistan, digital technologies are rapidly being integrated into architecture, urban planning, and construction. One of the most significant tools driving digital transformation is Building Information Modeling (BIM). BIM is not merely the creation of a 3D building model but a comprehensive process for managing information at all stages of a building's life cycle: from concept and design to construction, operation, and demolition. This technology optimizes workflows, enhances collaboration between participants, and improves the quality of design documentation.

BIM integrates architectural, engineering, and economic data into a unified information environment. Given the rapid pace of urbanization and the need to improve the built environment's quality, BIM implementation is not only relevant but also a strategically important solution for Uzbekistan. BIM technology addresses key challenges in the construction industry, such as minimizing design errors, improving process control, and reducing costs at all stages.

The digital transformation of the construction sector requires updating regulatory frameworks and creating conditions for training qualified professionals capable of working with BIM technologies. Despite existing challenges, such as financial costs and the need for specialized training, BIM implementation represents a long-term investment in the industry's development.

METHODS

The preparation and formalization of design documentation using BIM technology employ the following methods that encompass the entire design and data management cycle:

1. Development of Electronic BIM Models:
   - Creating 3D models using software such as Autodesk Revit, ArchiCAD, Tekla Structures, and Bentley Systems;
   - Integrating data on architecture, building structures, and engineering systems;
   - Continuously updating models based on changes and corrections.
2. Compliance with Approved Standards and Regulations:
   - Adhering to international and national standards (e.g., GOST 21.101, GOST 21.501, and SNiP);
   - Developing guidelines and requirements for documentation based on BIM.
3. Integration of Classification and Identification Systems:
   - Implementing parametric libraries and standardized codes for data structuring;
   - Grouping information into fields (A, B, C, D, and E) for enhanced management.
4. Creation of Working and As-Built Documentation:
   - Generating drawings, specifications, and schedules directly from BIM models;
   - Real-time updates of documentation with project changes.

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5. Interdisciplinary Coordination and Collaboration:
   - Using collaboration tools (e.g., Autodesk BIM 360, Navisworks) to detect clashes and improve coordination;
   - Optimizing interactions among architects, engineers, and builders.
6. Analysis and Simulation of Project Parameters:
   - Modeling energy efficiency, thermal losses, acoustics, and lighting;
   - Analyzing structural solutions and optimizing the construction process.
7. Training Specialists and Developing Competencies:
   - Organizing training courses for BIM specialists;
   - Creating retraining programs for designers and engineers.

RESULTS

The implementation of BIM technologies has yielded the following significant results:

1. Improved Quality of Design Documentation:
   - Elimination of errors through automated updates of data and drawings;
   - More precise and detailed design solutions.
2. Optimization of Time and Resources:
   - Reducing design documentation preparation timelines through automation;
   - Efficient resource use through accurate material calculations and work schedules.
3. Enhanced Coordination Among Project Participants:
   - Effective collaboration on a single information platform;
   - Minimizing clashes and inconsistencies among project sections.
4. Systematization of Data and Life Cycle Management:
   - Structuring information by fields and categories;
   - Simplified management of design and operational data at all stages.
5. Energy Efficiency Analysis and Design Optimization:
   - Modeling building parameters to improve operational characteristics.

DISCUSSION

The application of BIM technology in preparing design documentation helps resolve numerous challenges faced by designers and builders. Primarily, BIM minimizes errors and inconsistencies that are prevalent in traditional design methods. 3D modeling allows for a visual representation of design solutions and facilitates the rapid incorporation of necessary changes.

- Current Issues and Implementation Barriers:
- Non-Compliance with Regulatory Requirements:

Existing building codes and standards do not always account for the specifics of BIM technology, creating difficulties in preparing documentation. It is necessary to develop and adapt national standards aligned with international requirements.

- Lack of Qualified Specialists:

Successful implementation of BIM requires highly skilled professionals. Educational institutions and professional courses must actively integrate BIM training programs.

- Financial and Technical Barriers:

Implementing BIM requires significant investments in software, powerful hardware, and staff training. Small and medium-sized companies often struggle to transition to new technologies.

- Software Compatibility Issues:

Differences between BIM platforms can create integration and data exchange challenges.

- Advantages of BIM Implementation:
- Despite these challenges, the benefits of BIM make its adoption strategically critical:
- Improved accuracy in design and construction.
- Enhanced coordination and collaboration among project participants.
- Reduced project timelines and costs.
- Optimized building life cycles.
- Thus, the successful implementation of BIM can transform the design and construction approach, making it more efficient, transparent, and capable of meeting modern challenges.

CONCLUSIONS

Building Information Modeling (BIM) technology is a powerful tool for optimizing the processes of design, management, and preparation of construction documentation at all stages of a building's life cycle. The use of BIM significantly improves the quality of design solutions, minimizes errors, enhances coordination among participants, and reduces costs

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across all phases. Moreover, BIM contributes to improving building energy efficiency through detailed analysis and modeling of operational characteristics.

For successful BIM adoption, systematic training of specialists, adaptation of regulatory documents to modern standards, and the creation of conditions for technical re-equipment of design organizations are essential. Special attention should be given to developing a comprehensive national program to support BIM implementation, laying a sustainable foundation for the construction industry's development.

In the context of global digital transformation, BIM implementation is a crucial step toward the development of a modern and competitive construction sector in Uzbekistan. This technology will not only enhance project management efficiency but also make the industry more transparent, sustainable, and aligned with international quality standards.

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