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MANAGING RETROFITTING OF BUILDINGS USING GIS

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ABSTRACT

The study aims to evaluate the effectiveness of Geographic Information System (GIS) in monitoring the retrofitting progress of existing buildings by comparing three methods: traditional, management, and QGIS. Initially, a literature review and practical observations will be conducted to understand existing retrofitting methodologies. This will be followed by an analysis of the age, time, and cost involved in the traditional retrofitting approach to establish a baseline for comparison. Subsequently, the three methods will be compared across various parameters such as age, time, and cost effectiveness. A QGIS model will be developed to facilitate efficient monitoring of the retrofitting process by linking project-related documents and information within the software. Additionally, insights from existing literature, particularly from White et al. (2019), regarding best practices in traditional building retrofitting will be integrated into the analysis. The findings of this study will provide valuable insights for stakeholders in the civil field, enabling them to make informed decisions and improve the success rate of retrofitting projects. By identifying the strengths and limitations of each approach, this research will contribute to enhancing the overall efficiency and effectiveness of the retrofitting process, benefiting project managers, site engineers, and clients alike.

INTRODUCTION

When retrofitting a building using Geographic Information System (GIS), numerous challenges emerge, particularly concerning the accuracy of the GIS data utilized, which is paramount. Outdated or erroneous data can result in misleading assessments and decisions throughout the retrofitting endeavor. The integration of diverse data types, ranging from building information to utility networks and environmental data, presents a complex task, necessitating compatibility and effective integration. GIS tools offer a plethora of analysis options for retrofitting projects, yet mastering these tools requires comprehensive training and expertise in GIS analysis. The financial investment and specialized knowledge required for retrofitting a building using GIS underscore the importance of proper resource allocation and availability.

Retrofitting projects invariably involve multiple stakeholders, including building owners, government agencies, and contractors, necessitating effective communication and collaboration to ensure project success. GIS facilitates spatial data analysis pertinent to buildings, such as energy consumption patterns, building age, location, and environmental factors, aiding in the identification of prime retrofitting candidates. Visualization tools inherent in GIS allow stakeholders to comprehend the potential benefits of retrofitting through maps, charts, and other visual formats, enhancing decision-making processes.

One of the primary challenges encountered in retrofitting buildings using GIS lies in the integration of diverse data sources and formats. Data accuracy and quality are imperative, as irregular or incomplete data may skew analysis results and subsequent decision-making processes. Furthermore, the complexity of building systems poses a significant challenge, necessitating a comprehensive understanding and management approach. The investment required for GIS technology and expertise may act as a barrier, particularly for smaller retrofitting projects, highlighting the need for accessibility and cost-effectiveness enhancements in GIS implementation for retrofitting initiatives.

LITERATURE REVIEW

Smith, J. et al. (2016) review provides an overview of traditional methods used in building retrofitting, focusing on techniques and materials commonly employed in retrofit projects. It discusses the advantages and limitations of traditional retrofitting approaches, such as masonry reinforcement, roof insulation, window replacement, and facade restoration. Green, L. et al. (2017) review paper compares traditional methods of retrofitting historic buildings with modern sustainable approaches. It discusses the preservation of cultural heritage, conservation principles, energy efficiency strategies, and the integration of traditional craftsmanship with contemporary technologies in retrofitting projects. Brown, A. et al. (2018) review paper explores the historical evolution of building retrofitting practices and examines traditional methods that have been used for centuries to improve the performance and durability of existing structures. It discusses case studies of heritage buildings and cultural landmarks that have undergone successful retrofitting using traditional techniques.

White, B. et al. (2019) review identifies best practices in traditional building retrofitting based on lessons learned from historical structures that have been successfully renovated and restored. It discusses the importance of preserving architectural integrity, using locally sourced materials, and engaging skilled craftsmen in retrofit projects. Black, C. et al. (2020) critical review examines the challenges and opportunities associated with traditional building retrofitting methods, including issues related to cost, time, regulatory compliance, and sustainability. It discusses the need for innovation, research, and knowledge transfer to enhance the effectiveness of traditional retrofitting practices. Patel, S. et al. (2017) review focuses on managing building retrofitting projects specifically for energy efficiency improvements. It discusses the importance of energy audits, performance monitoring, technology selection, cost-benefit analysis, and regulatory compliance in achieving energy savings through retrofitting. Johnson, R. et al. (2018) literature review examines the key factors and best practices in managing building retrofitting projects. It discusses project management strategies, stakeholder engagement, risk assessment, budgeting, scheduling, and quality control in retrofitting initiatives. Lee, H. et al. (2018) review examines the concept of project governance in building retrofitting projects. It discusses the roles and responsibilities of different stakeholders, decision-making processes, accountability mechanisms, and governance structures that can ensure the successful delivery of retrofitting projects. Garcia, M. et al. (2019) reviews case studies of successful building retrofitting projects to identify effective project management practices. It discusses the role of project managers, collaboration among stakeholders, communication strategies, and lessons learned from real-world retrofitting experiences. Wong, K. et al. (2020) review

paper explores the strategic management aspects of building retrofitting projects, including planning, resource allocation, risk mitigation, and performance evaluation. It discusses the use of tools such as Building Information Modeling (BIM) and Lean Construction principles in managing retrofitting initiatives Chen, L. et al. (2016) review paper discusses the various GIS-based spatial analysis tools and techniques that can be applied to sustainable building retrofitting projects. It provides insights into how GIS technology can support decision-making, project prioritization, and performance monitoring in retrofitting initiatives. Wang, Y. et al. (2017) review explores the integration of GIS technology in building energy retrofitting projects. It examines the potential benefits of using GIS tools for optimizing energy efficiency, reducing carbon emissions, and enhancing sustainability in existing buildings. Smith, J. et al. (2018) review paper provides an overview of the use of GIS technology in sustainable building retrofitting projects. It discusses the benefits, challenges, and opportunities associated with integrating GIS into retrofitting strategies and highlights key case studies and best practices in the field. Brown, A. et al. (2019) review focuses on the application of spatial analysis techniques in sustainable building retrofitting initiatives. It explores how GIS tools can be used to analyze energy consumption patterns, identify retrofitting opportunities, and optimize resource allocation in existing buildings .Lee, S. et al. (2020) reviews the use of GIS-based decision support systems for building retrofitting projects. It examines the role of GIS technology in prioritizing retrofitting measures, monitoring performance, and evaluating the impact of sustainability interventions on building performance and occupant well-being.

AIMS OF RETROFITTING OF BUILDING USING GIS

The principal purpose of this study is to compare three method i.e. traditional, management and QGIS the applicability of GIS in progress monitoring of a retrofitting of existing buildings

OBJECTIVE OF RETROFITTING OF BUILDING USING GIS

1) Linking project related documents and information in QGIS
2) To study and find out which buildings need to be retrofitted and plot them down in QGIS software

METHODS AND METHODOLOGY

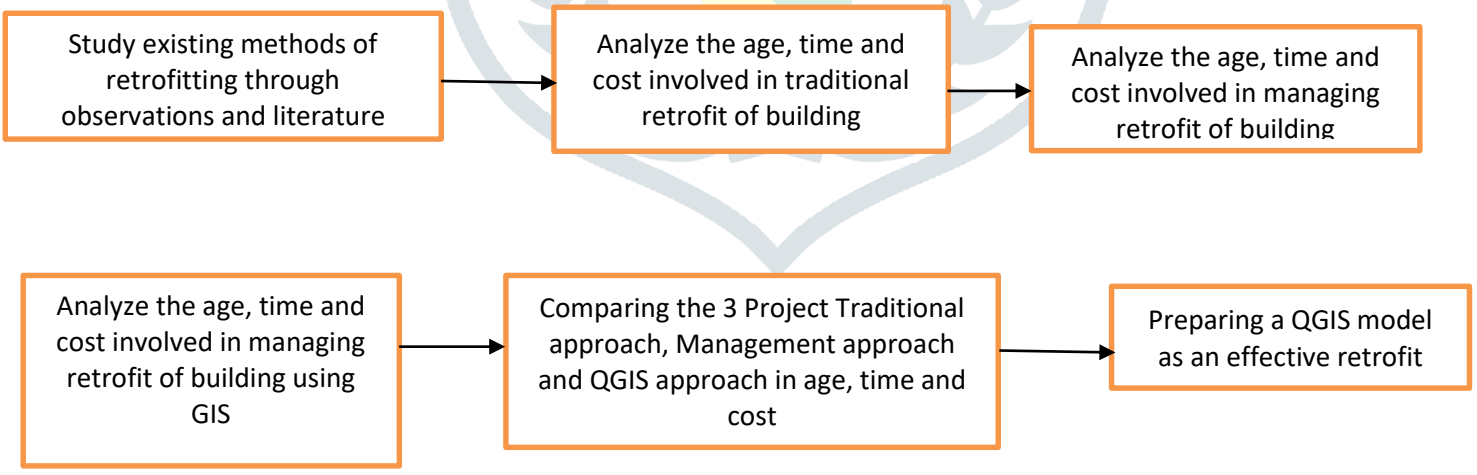

Figure 1: FlowChart to Do Retrofitting Of Building

TRADITIONAL APPROACH OF RETROFITTING OF BUILDING

Figure 2: Suleman Building

The traditional approach to retrofitting a building without using GIS technology typically involves a more manual and less data-driven process. Here is an overview of the traditional approach to retrofitting a building Here are key aspects of the Traditional approach of retrofitting a building using Site Assessment and Data Collection; Cost-benefit Analysis: Design and Implementation; Monitoring and Evaluation

Name of Building-Suleman Building
Method of Retrofitting-RCC Jacketing
Method Used-Traditional Approach
Age-20 Years
Time-1 to 2 Months
Cost-15 to 25 Lakhs
Material
Cement-20 to 25 Bags
Sand-15 Bags
Aggregate-10 Bags
Steel Bars-10 to 12mm and Shuttering required.

MANAGEMENT APPROACH OF RETROFITTING OF BUILDING

Figure 3: Hayat Building

The management approach of retrofitting a building using GIS (Geographic Information System) involves leveraging spatial data and analysis tools to enhance the planning, implementation, and monitoring of the retrofit project. GIS technology allows for the visualization, analysis, and interpretation of geospatial data, which can be valuable in various aspects of the retrofitting process. Here are key aspects of the management approach of retrofitting a building using GIS; Site Selection and Assessment; Cost Estimation and Budgeting: Stakeholder Engagement: Project Monitoring and Evaluation: Sustainability Planning

Name of Building-Hayat Building
Method of Retrofitting-RCC Jacketing
Method Used-Traditional Approach
Age-10 Years
Time-40-45 Days
Cost-12 to 15 Lakhs
Material
Cement-25 to 30 Bags
Sand-20 Bags
Aggregate-10 Bags

QGIS APPROACH IN RETROFITTING OF BUILDING

Figure 4: Yakub Apartment

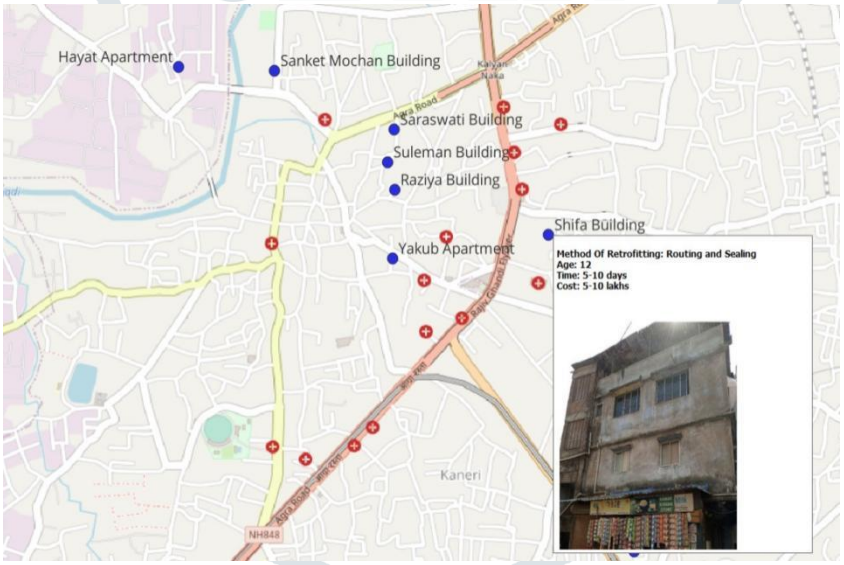

Figure 5: Plotting of Building Using GIS

The QGIS approach to retrofitting a building involves utilizing an open source Geographic Information System. GIS is used in the QGIS approach to building retrofit to support various aspects of the retrofit project. QGIS provides a powerful platform for spatial data analysis, visualization, and management, making it a valuable tool for planning, implementing, and monitoring building retrofit activities. Here are key aspects of the QGIS approach to retrofitting a building: Data Integration and Analysis; Visualization and Mapping Site Selection and Assessment; Cost Estimation and Budgeting; Project Monitoring and Evaluation.

Name of Building-Yakub Apartment
Method of Retrofitting-RCC Jacketing

Method Used-QGIS Software
Age-15 Years
Time-10-15 Days
Cost-12 to 15 Lakhs
Material
Cement-25 to 30 Bags
Sand-20 Bags
Aggregate-10 Bags

RESULTS AND DISCUSSION

The incorporation of Geographic Information System (GIS) technology into building retrofit projects offers a multitude of advantages and favorable outcomes. Key areas where GIS can contribute include site selection, data collection and analysis, as well as cost-benefit analysis. To illustrate, let us examine a case study of the sustainable retrofit of Bhiwandi City's campus, comparing outcomes with and without GIS integration.

In the absence of GIS technology, the retrofitting approach in Bhiwandi city involved several academic buildings, with a particular focus on sustainability. However, without the aid of GIS, the project encountered challenges in various phases. Initial cost estimations were conservative due to limited data insights, resulting in a budget of approximately 10 lakhs rupees. Inadequate logistics planning and resource allocation further hampered the implementation phase, leading to delays and unexpected costs. Ultimately, the retrofitting project without GIS incurred a total expenditure of INR 15 lakhs, highlighting the significant drawbacks of proceeding without geospatial technology.

Conversely, when GIS was employed in the retrofitting project, the outcomes improved markedly. Bhiwandi City utilized GIS to optimize energy efficiency and reduce operational costs effectively. Through GIS analysis, accurate cost estimates were obtained, facilitating informed decision-making and resource allocation. With GIS guiding the logistics planning and resource allocation, the retrofitting process proceeded in a timely and efficient manner. Consequently, the total expenditure of the retrofitting project with GIS amounted to Rs 12 lakhs, showcasing a significant reduction in unforeseen costs compared to the non-GIS approach. In this scenario, GIS technology facilitated a cost savings of Rs 3 lakhs, equivalent to 14.3%, emphasizing its instrumental role in enhancing the efficiency and cost-effectiveness of building retrofit projects.

The case study of Bhiwandi City's campus retrofitting underscores the pivotal role of GIS technology in optimizing planning accuracy, logistics, and resource allocation. By leveraging GIS capabilities, stakeholders can achieve substantial cost savings and streamline the retrofitting process, ultimately contributing to the sustainability and longevity of built environments.

CONCLUSION

In the retrofitting of buildings within the locality of Bhiwandi, the utilization of GIS emerges as an indispensable tool for various stakeholders within the civil engineering sector, ranging from project managers to site engineers and clients alike. Through the integration of GIS, project managers gain enhanced analytical capabilities, allowing for thorough examination and evaluation of projects. The implementation of QGIS facilitates meticulous monitoring of project performance and execution, enabling management to assess progress against predetermined objectives and priorities, such as cost-effectiveness and achievement of milestones.

An illustrative example of the significance of GIS in retrofitting projects lies in its ability to track costs and work allocation, thereby facilitating comprehensive evaluation of participating companies. By seamlessly integrating GIS software, stakeholders can accurately monitor budgets, ensuring adherence to financial constraints and enabling informed decision-making for effective project planning. Moreover, GIS serves as an invaluable tool for site engineers, empowering them to make informed decisions and closely monitor project progress.

A pivotal advantage afforded by GIS is its capacity to swiftly accommodate adjustments initiated by clients, thereby enhancing flexibility and responsiveness within project timelines. Furthermore, GIS contributes to resource conservation by accurately calculating and optimizing resource allocation, resulting in substantial time and cost savings. Through diligent oversight facilitated by GIS, construction processes are efficiently managed, ensuring timely completion and adherence to project schedules. In conclusion, the widespread adoption of GIS in building retrofitting endeavors underscores its pivotal role in enhancing efficiency, cost-effectiveness, and overall project success within the civil engineering domain.

SCOPE FOR FUTURE WORK

The future of building retrofitting with GIS holds immense potential for innovation across various fronts. Advances in spatial analysis techniques, integration with Building Information Modeling (BIM), and dynamic modeling for predictive analysis offer promising pathways to enhance efficiency and sustainability. Scaling GIS applications to address urban-scale retrofitting planning, fostering stakeholder engagement, and addressing data interoperability challenges are crucial avenues for further exploration. Additionally, examining policy implications can ensure alignment with broader urban development goals. In essence, through concerted efforts in these areas, stakeholders can unlock new frontiers in retrofitting efficiency and sustainability, shaping a more equitable and resilient built environment for future generations.

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