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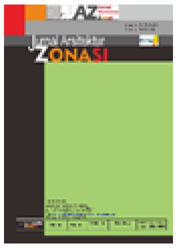

Development of An Intelligent AI Agent For Revit-Based BIM Architectural Design Automation In Tropical Buildings

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ABSTRACT

The development of Artificial Intelligence (AI) has created new opportunities for innovation in architectural design, particularly through integration with Building Information Modeling (BIM) systems. This study examines the potential integration of AI with Autodesk Revit 2021 in supporting the automation of architectural design processes, especially for tropical buildings. The research employs a qualitative descriptive approach using literature review and conceptual development methods to analyze the integration of intelligent AI agents within BIM-based design environments. The study relies on secondary data obtained from scientific journals, conference proceedings, academic books, research reports, and technical documents related to AI, BIM, generative design, design automation, and tropical architecture principles. A preliminary exploration of the Revit platform was also conducted to understand the potential implementation of AI-assisted BIM workflows. The study explores the integration of generative AI platforms such as Google Gemini, Claude, and Groq within BIM environments to support natural language-based design interaction, design exploration, and workflow automation. The findings indicate that AI-assisted BIM integration has significant potential to improve workflow efficiency, enhance design adaptability, and support intelligent architectural decision-making. However, challenges related to operational costs, hardware limitations, and technical competencies remain important considerations in implementing AI within architectural practice.

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1. INTRODUCTION

The integration of Generative Artificial Intelligence (GenAI) with Building Information Modelling (BIM) has emerged as a highly transformative innovation, although its potential remains relatively underexamined in the Construction and Built Environment (CBE) industry (Tam, N.V., & Phong, V.V., 2026). Artificial Intelligence (AI) is rapidly advancing and has significantly transformed architectural design processes. The projection indicates that, in line with demographic changes, the demand for smart green buildings and more advanced technologies will continue to increase (Depari, A. S. 2025). According to the AI Report 2024 published by the Royal Institute of British Architects, AI technology has emerged as a critical component in supporting the evolution of contemporary architectural practice (Jang, S et al., 2025). The implementation of AI in architecture is no longer limited to design visualization; it increasingly encompasses analytical processes, building performance evaluation, design data processing, and computational decision-making. This development indicates that digital transformation in architecture is progressively shifting toward more adaptive, automated, and data-driven approaches.

On the other hand, the advancement of Building Information Modeling (BIM) has also driven a paradigm shift in architectural design practice through its capability to maintain design integrity while providing an integrated information source that supports more accurate, collaborative, and coordinated decision-making processes (Sacks, R et al., 2018). BIM enables the integration of various building-related data into a unified digital ecosystem capable of enhancing efficiency throughout the design, construction, and building operation phases. In this context, the integration of BIM and AI has emerged as a promising approach for developing more intelligent, adaptive, and responsive architectural design systems.

As a widely adopted information technology within the Architecture, Engineering, Construction, and Operations (AECO) industry, Building Information Modeling (BIM) plays a significant role in facilitating effective collaboration, coordination, and data management throughout the entire project lifecycle (Li, X et al., 2017). BIM enables stakeholders to work within a shared digital environment that supports real-time information exchange, improves communication among multidisciplinary teams, and enhances the accuracy and consistency of project data. Furthermore, the implementation of BIM contributes to improved project efficiency, reduced design conflicts, optimized construction processes, and more effective building operation and maintenance, thereby supporting integrated and data-driven approaches in contemporary architectural and construction practices.

Artificial Intelligence (AI) is projected to become the next frontier in the evolution of digital architecture by enabling architects to interpret diverse sources of information more comprehensively, including project scope, site conditions, user requirements, technical standards, and design documentation (J. Manyika et al., 2017). Furthermore, AI has the potential to enhance the efficiency of design alternative exploration through its adaptive analytical and generative capabilities. This technology enables more responsive decision-making processes while simultaneously considering multidimensional aspects such as spatial functionality, aesthetics, sustainability, thermal comfort, energy efficiency, and socio-environmental contexts. With these capabilities, AI is no longer positioned merely as a visualization support tool, but rather as an intelligent computational system capable of facilitating more structured, measurable, and data-driven design thinking processes.

The advancement of AI technologies with increasingly sophisticated sensing, cognitive, and generative capabilities has also fundamentally transformed the paradigms of architecture and construction (*Yuan, P.F et al., 2025)*. AI is no longer merely positioned as a supporting technology; rather, it has evolved into a critical component driving the transformation of design processes, simulations, performance analysis, and building management toward more efficient and data-driven approaches. In the context of intelligent buildings, buildings are no longer perceived simply as integrations of automated systems, but as complex entities capable of sensing environmental conditions, continuously optimizing building performance, dynamically adapting to changes, and maintaining ongoing interactions with occupants (Yussuf, R.O et al., 2024).

These developments indicate that future architectural design approaches will increasingly depend on the integration of digital technologies and computational intelligence. Although the advancement of AI and BIM in architecture demonstrates considerable potential, the implementation of intelligent AI agents within BIM Revit-based architectural design processes, particularly for tropical buildings, remains relatively limited. In fact, tropical buildings involve highly complex design considerations due to the need to respond effectively to climatic conditions such as intense solar radiation, high air temperatures, humidity, rainfall, natural ventilation requirements, and energy efficiency demands. Therefore, an integrated approach that combines AI with BIM Revit is required to support more adaptive and context-sensitive design automation processes tailored to the characteristics of tropical climates.

Based on these challenges, this study aims to develop an intelligent AI agent integrated with BIM Revit to support the automation of architectural design processes for tropical buildings. The proposed system is expected to enhance design efficiency, facilitate faster and more adaptive exploration of design alternatives, and support data-driven and performance-based architectural decision-making. Furthermore, this research is anticipated to contribute to the advancement of digital architecture and the implementation of AI technologies in architectural design processes that are more innovative, responsive, and sustainable.

2. RESEARCH METHODOLOGY

This study employs a qualitative descriptive approach using literature review and conceptual development methods to examine the potential integration of Artificial Intelligence (AI) with Building Information Modeling (BIM) Revit in supporting the automation of architectural design processes for tropical buildings. This approach was selected because the research focuses on the analysis of concepts, technologies, and the development of an integration framework for intelligent AI agents within BIM-based design environments. The study primarily relies on secondary data obtained from scientific journals, conference proceedings, academic books, research reports, and technical documents related to AI, BIM, generative design, design automation, and tropical building principles. In addition to the literature review, a preliminary exploration of the Autodesk Revit platform was also conducted to understand the potential integration of AI into BIM-based architectural design processes.

The data were analyzed using descriptive and comparative approaches to identify the potential implementation of AI in improving design process efficiency, exploring design alternatives, and supporting data-driven architectural decision-making. Through this approach, the study is expected to produce a conceptual framework for the development of an intelligent AI agent capable of supporting architectural design processes for tropical buildings in a more adaptive, efficient, and integrated manner.

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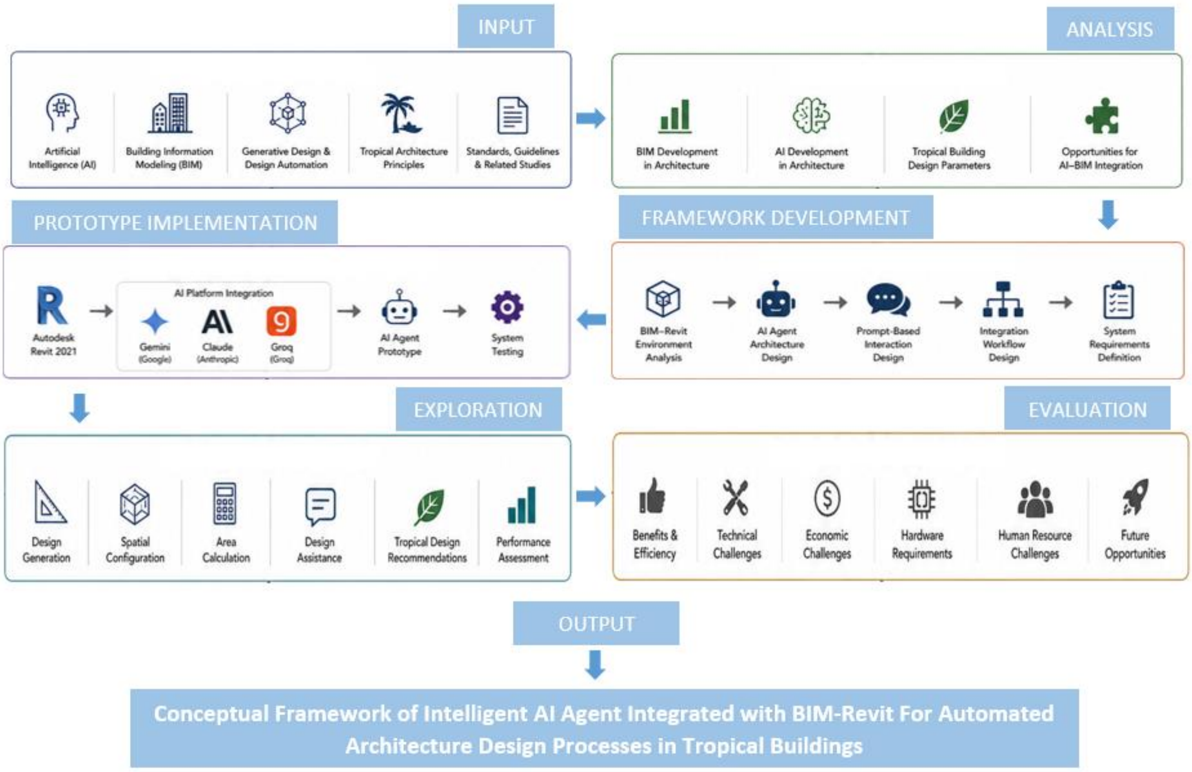

Figure 1. Flowchart
(Source: Author, 2026)

3. RESULT AND DISCUSSION

3.1 Development of Artificial Intelligence (AI) and BIM in Architecture

Building Information Modeling (BIM) is a digital representation of a facility that encompasses both its physical and functional characteristics, enabling a comprehensive and integrated information environment throughout the building lifecycle (Wei, Y., Li, X., & Petzold, F., 2025). BIM provides a collaborative platform that facilitates coordination and information exchange among multiple stakeholders, including architects, engineers, construction professionals, and facility management specialists. Through this integrated approach, BIM enhances decision-making processes, improves design accuracy, reduces conflicts during construction, and supports efficient facility operation and maintenance. As a result, BIM is widely recognized as a fundamental framework in contemporary digital architecture and construction practices, enabling more coordinated, data-driven, and lifecycle-oriented project delivery.

Architectural design is a highly complex and multidisciplinary process that requires not only technical expertise and professional experience, but also creativity, critical thinking, and artistic sensitivity (Xin, Y., Zhou, Y., & Liu, Y., 2025). Architects are expected to integrate multiple design considerations, including spatial functionality, aesthetics, environmental responsiveness, user requirements, and regulatory constraints, into coherent and meaningful architectural solutions. This complexity highlights the iterative and knowledge-intensive nature of architectural design, where analytical reasoning and creative exploration play equally important roles in shaping the built environment. In recent years, the rapid development of digital technologies has significantly transformed architectural practices, particularly through the emergence of Artificial Intelligence (AI) and computational design approaches that enable more adaptive, efficient, and data driven design processes.

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With the advancement of computational architecture, substantial progress has been achieved in automated architectural layout generation. Numerous algorithms, computational methods, and Generative Architectural Design (GAD) models have been introduced to support the generation of spatial configurations and design alternatives in a more systematic and efficient manner (Aalaei, M.R. et al., 2023). These technologies enable architects to explore complex design possibilities through algorithmic and data oriented processes while reducing the time required for iterative design development. AI-based systems also offer the capability to analyze design parameters, predict performance outcomes, and generate alternative solutions based on predefined criteria. Nevertheless, conditional architectural layout generation, where design outputs must respond dynamically to contextual conditions, environmental factors, user preferences, and functional requirements remains a major challenge and continues to represent an important area of research within contemporary architectural computing.

Simultaneously, building projects within the Architecture, Engineering, and Construction (AEC) sector increasingly involve collaboration among multiple stakeholders, including project owners, managers, consultants, designers, subcontractors, suppliers, and future occupants (Dong, Y. et al., 2025). Each stakeholder contributes different expertise, objectives, and project expectations throughout the building lifecycle, from conceptual planning and design to construction and facility operation. This multidisciplinary collaboration creates a highly complex decision-making environment that requires effective coordination, communication, and information exchange to ensure project efficiency and building performance. Consequently, the growing complexity of architectural projects has accelerated the adoption of digital technologies capable of supporting integrated and collaborative workflows.

To enhance efficiency and project performance, the AEC industry continuously adopts emerging technologies, particularly Building Information Modeling (BIM) tools. BIM has evolved into a fundamental digital framework that enables integrated information management, interdisciplinary collaboration, and more accurate decision-making throughout the entire building lifecycle (Hu, Y., & Dossick, C.S., 2023). By centralizing building-related data within a shared digital environment, BIM improves coordination among stakeholders, minimizes design conflicts, and supports more efficient planning, construction, and operational processes. Furthermore, the integration of AI with BIM represents a significant advancement in digital architecture, enabling the development of intelligent and automated design systems capable of analyzing design data, optimizing building performance, and supporting real-time decision-making. This integration demonstrates the growing shift toward intelligent computational environments in architecture, where AI and BIM collectively contribute to more responsive, adaptive, and sustainable architectural design practices.

3.2 Characteristics of Tropical Buildings as Design Parameters

Tropical regions are characterized by consistently high ambient temperatures, intense solar radiation, and elevated humidity levels throughout the year, all of which significantly influence building performance and occupant comfort. These climatic conditions create substantial thermal challenges for buildings, particularly in maintaining comfortable indoor environments while minimizing energy consumption. Consequently, tropical buildings require climate-responsive design approaches that prioritize passive environmental strategies such as natural ventilation, solar shading, daylight optimization, passive cooling, and energy-efficient building envelopes in order to reduce dependence on mechanical cooling systems and improve overall environmental performance (Erdiwansyah, Mamat, R. et al., 2026). In this context, climatic responsiveness becomes a critical design parameter in tropical architecture,

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influencing building orientation, façade configuration, material selection, spatial organization, and thermal performance strategies.

The rapid growth of urban populations and economic development in many tropical countries has further intensified the demand for indoor thermal comfort in residential, commercial, and public buildings. As urbanization increases, the use of high-density building typologies and enclosed indoor environments has led to a growing reliance on mechanical air-conditioning systems to maintain acceptable thermal conditions. While these technologies contribute to occupant comfort and productivity, their extensive use significantly increases building energy consumption, operational costs, and environmental impacts. This condition highlights the importance of integrating sustainable and adaptive design parameters into tropical building design in order to balance occupant comfort with energy efficiency and environmental sustainability.

According to recent studies, Heating, Ventilation, and Air Conditioning (HVAC) systems account for approximately 50–70% of total building energy consumption in hot climate regions, making buildings one of the primary contributors to electricity consumption and greenhouse gas (GHG) emissions (Choi et al., 2024; Ibrahim et al., 2024; Yan et al., 2024). These findings emphasize the urgent need for more efficient and climate-responsive architectural solutions capable of reducing cooling loads and improving building performance in tropical environments. As a result, design parameters such as building orientation, shading systems, façade articulation, airflow optimization, thermal insulation, and natural lighting have become increasingly important in contemporary tropical architecture. Furthermore, the integration of digital technologies, including Artificial Intelligence (AI) and Building Information Modeling (BIM), offers new opportunities to analyze and optimize these design parameters more effectively through data-driven and performance-based architectural approaches.

3.3 Concept of Intelligent AI Agent Integration with BIM Revit

The urgent need for building decarbonization requires a fundamental paradigm shift in future autonomous building energy operations, transitioning from conventional human-intensive engineering workflows toward intelligent agents capable of interacting with physics-grounded digital environments. This transformation emphasizes the growing role of computational intelligence in managing building performance more efficiently, adaptively, and sustainably (Jiang, Z et al., 2026). By integrating intelligent agents with digital building systems, energy operations can become more responsive to environmental conditions, occupant behavior, and real-time performance data, thereby supporting optimized energy consumption and reduced carbon emissions within the built environment.

AI Agent integration with Building Information Modeling (BIM) Revit represents an emerging approach in digital architecture that combines computational intelligence with data-driven building modeling to support more efficient and adaptive architectural design processes. Through this integration, AI agents can interact with BIM environments to analyze design data, interpret project parameters, automate repetitive tasks, generate design alternatives, and assist architects in decision-making processes. By utilizing the centralized and information-rich ecosystem provided by BIM Revit, AI agents are capable of processing spatial, environmental, and performance-related data in real time, enabling more responsive and optimized design solutions. This integration also supports improved collaboration, workflow automation, and performance-based design evaluation, particularly in complex projects such as tropical buildings that require climate-responsive and energy-efficient architectural strategies.

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The following section presents the AI agent developed in this research, which is designed to be readable, executable, and directly integrated into Autodesk Revit 2021. The proposed AI agent was developed to support BIM-based architectural design processes through integration with generative AI platforms such as Google Gemini, Claude, and Groq. This integration enables users to provide natural language prompts that can be interpreted by the AI agent and translated into automated design operations within the BIM environment, including design generation, element modification, spatial configuration, area calculation, and design parameter processing. Natural language-based BIM interaction applications generally involve three main sequential processes, including receiving and parsing user instructions expressed in natural language, interpreting and understanding the user's requests, and subsequently generating appropriate responses or feedback based on the given commands (Zheng, J., & Fischer, M., 2023). Within this process, accurately understanding user requests and extracting the necessary information are essential to support the subsequent manipulation and modification of relevant properties within BIM software environments (Saka, A.B et al., 2023). Furthermore, the developed system aims to enhance the efficiency, adaptability, and intelligence of architectural workflows by enabling real-time interaction between generative AI and BIM-based design environments.

```
import clr
import json
import re

clr.AddReference('RevitAPI')
clr.AddReference('RevitAPIUI')
clr.AddReference('System.Windows.Forms')
clr.AddReference('System.Drawing')

import System.Windows.Forms as WF
from Autodesk.Revit.DB import *
from Autodesk.Revit.DB.Structure import StructuralType
from System.Windows.Forms import (
    Form, Label, TextBox, Button, RichTextBox,
    Panel, FormStartPosition, FormBorderStyle,
    BorderStyle, TabControl, TabPage, FlowLayoutPanel
)
from System.Drawing import Size, Point, Font, Color, FontStyle
from System.Net import WebClient, WebException
from System.Text import Encoding
from System.IO import StreamReader

doc = __revit__.ActiveUIDocument.Document
uidoc = __revit__.ActiveUIDocument
```

Figure 1. Script Example Screenshot
(Source: Author, 2026)

Despite their growing capabilities, AI agents still exhibit several significant limitations, including the tendency to generate hallucinated or inaccurate outputs, difficulties in performing complex mathematical computations and logical reasoning tasks, and inconsistencies in code generation processes (Lecler, A et al., (2023). In addition, AI systems often demonstrate limited contextual understanding, particularly when interpreting highly specialized, dynamic, or domain-specific information. These limitations present important challenges for the implementation of AI in complex architectural and engineering workflows, where accuracy, contextual awareness, and reliable decision-making are critical requirements.

Despite the numerous advantages offered by generative AI technologies, several limitations remain, including the occurrence of hallucinated outputs, limited accuracy in complex logical and mathematical reasoning processes, insufficient contextual understanding of architectural design, and the lack of seamless integration with BIM-based architectural workflows. In response to these challenges, this study proposes the development and

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integration of an intelligent AI agent connected to generative AI platforms such as Google Gemini, Anthropic Claude, and Groq within Autodesk Revit 2021 as the primary platform for BIM-based architectural design and building information management. This integration is designed to establish a more responsive and adaptive design ecosystem capable of supporting architectural workflows through real-time interactions between AI agents and BIM models. Through this approach, the AI agent functions not merely as a generative assistant, but as an intelligent computational system capable of interpreting design data, providing parameter-based design recommendations, assisting building performance evaluations, and facilitating faster and more efficient design exploration processes. Furthermore, the study aims to contribute to the development of digital architectural design methodologies that are more closely aligned with tropical building requirements and sustainability principles, thereby positioning AI integration within BIM Revit not only as a tool for design automation, but also as a strategy for improving design decision quality, workflow efficiency, and the advancement of more intelligent and sustainable future architectural practices.

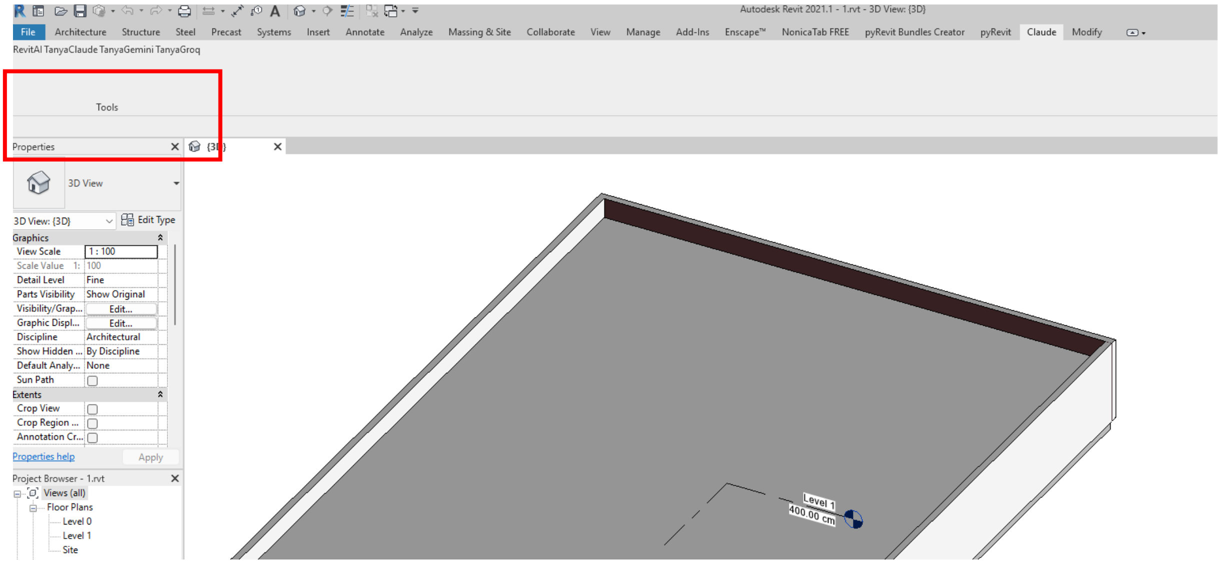

Figure 2. Screenshot of Claude, Gemini, and Groq in the BIM Revit 2021 application
(Source: Author, 2026)

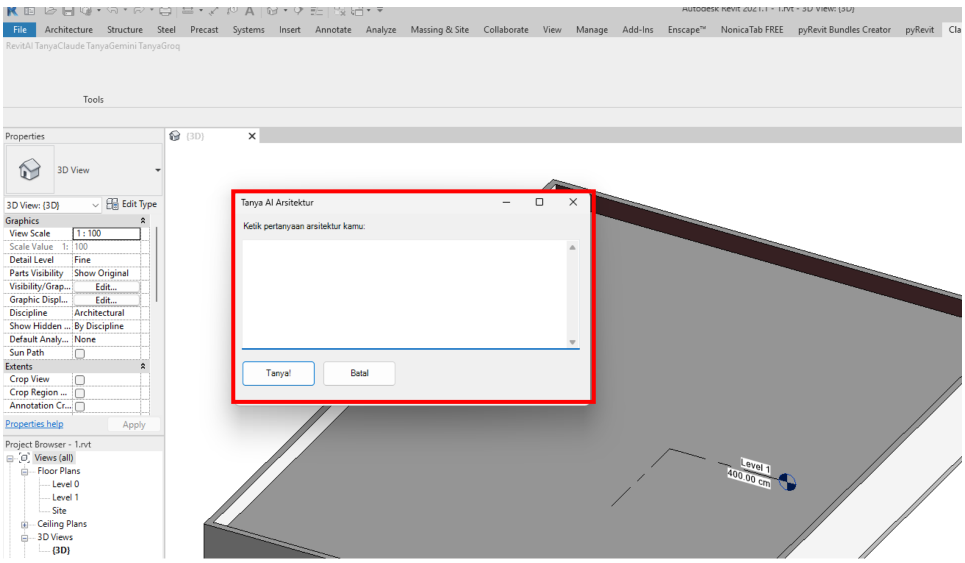

Figure 3. Groq Pop-up Screenshot in Revit 2021 Application
(Source: Author, 2026)

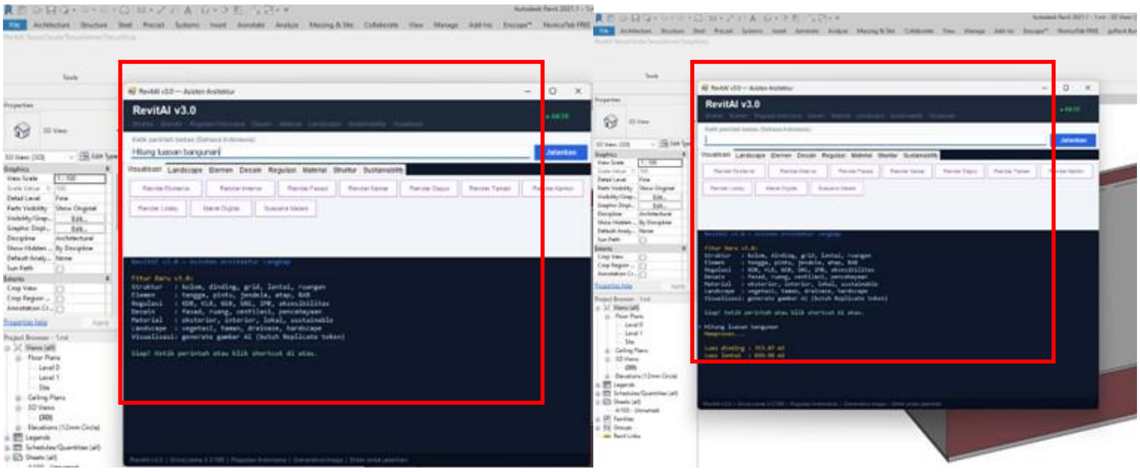

Figure 4. Revit AI Pop-up Screenshot for Area Calculation
(Source: Author, 2026)

This integration has the potential to significantly simplify architectural design workflows, as prompts or commands provided to the AI agent can be directly connected to and automatically influence design processes within Autodesk Revit 2021. Through integration with generative AI platforms such as Google Gemini, Anthropic Claude, and Groq, users can deliver natural language instructions to generate design alternatives, modify building elements, configure spatial parameters, and develop architectural concepts in a faster and more interactive manner. This system enables the AI agent to translate user instructions into direct actions within BIM models in Revit, thereby creating a more efficient, adaptive, and automated design environment. In addition to supporting design exploration, the integration also facilitates automated building data analysis and processing, including spatial area calculations, building element quantification, material estimation, and parameter-based design recommendations related to lighting, ventilation, and sustainable tropical building strategies. Consequently, the AI agent functions not only as a visualization support tool, but also as an intelligent design assistant capable of accelerating architectural decision-making, enhancing BIM workflow efficiency, and supporting the transformation of architectural design processes toward more digitalized, automated, and AI-driven systems.

3.4 Exploration of AI Agent Implementation in Tropical Building Design Processes

The exploration of AI agent implementation in this research is carried out by focusing on specific components and indicators embedded within the developed scripting system to facilitate BIM operation, particularly in architectural design processes within Autodesk Revit 2021. The developed AI agent is designed to simplify complex modeling workflows, automate repetitive design tasks, and enable interactive natural language-based commands within the BIM environment. Through integration with generative AI platforms such as Google Gemini, Claude, and Groq, the system allows users to provide prompts that can be directly translated into design operations, parameter modifications, spatial configurations, area calculations, and other BIM-related processes in real time.

In this study, the AI agent exploration is not only limited to tropical architectural design considerations, but also extends to broader architectural ideation and conceptual development processes. The scripting indicators developed within the system include parameters related to tropical building performance, such as natural ventilation, solar shading, thermal comfort, façade adaptation, and environmental responsiveness, while simultaneously supporting the generation of architectural ideas, massing alternatives, spatial concepts, façade compositions, and adaptive design strategies in a more general context. Consequently, the proposed AI agent functions not only as a technical BIM automation tool,

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but also as an intelligent design assistant capable of supporting creativity, accelerating decision-making processes, and enhancing design exploration within contemporary architectural practice.

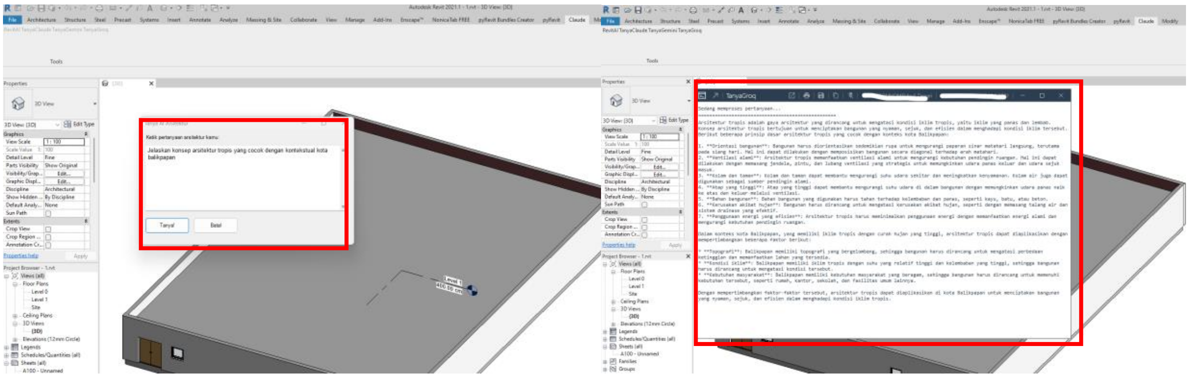

Figure 5. Brainstorming Concept Pop-up Screenshot in Revit 2021
(Source: Author, 2026)

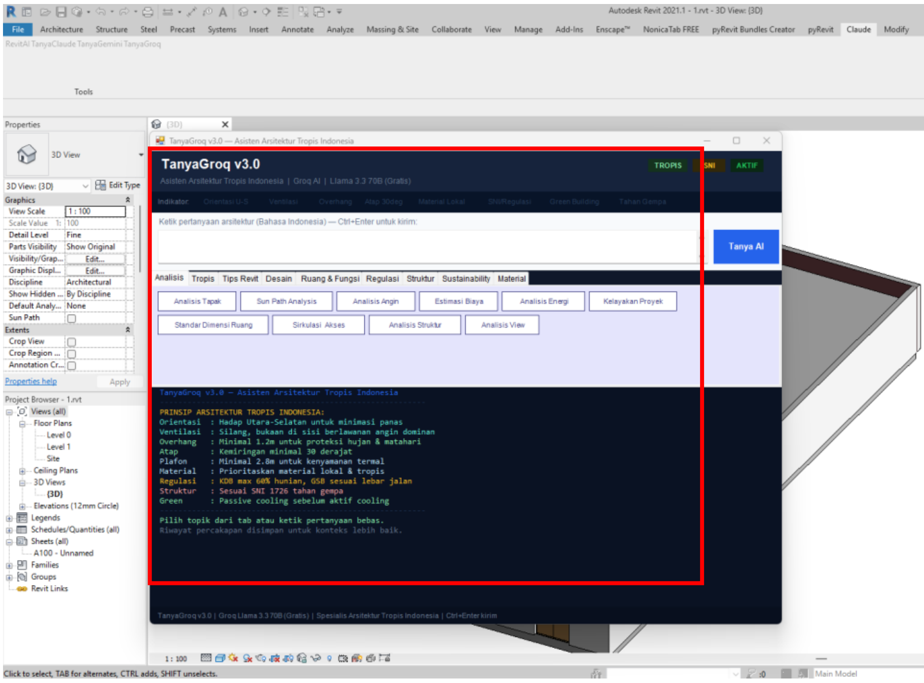

Figure 6. AI Focused on Indonesian Tropical Architecture
(Source: Author, 2026)

AI agents in supporting BIM Revit-based design processes have the capability to enhance the efficiency and flexibility of architectural workflows through more interactive and automated approaches. In their implementation, AI agents can assist users by translating natural language instructions into direct design operations within BIM models, enabling modeling processes, element modifications, parameter adjustments, and design evaluations to be performed more efficiently and systematically. This approach allows architects and designers to focus more on conceptual development and design decision-making rather than repetitive technical processes. Furthermore, the integration of AI within the Autodesk Revit environment provides opportunities for the development of more adaptive design workflows, where the system can generate recommendations, alternative design solutions, and real-time responses to parameter changes during the design process.

Furthermore, AI agents also have the potential to support broader design exploration processes through rapid data analysis and generative design ideation based on user

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requirements. Through integration with generative AI platforms such as Google Gemini, Claude, and Groq, the system can assist in generating architectural concepts, spatial organization strategies, façade alternatives, and design approaches that consider building performance and sustainability aspects. This demonstrates that AI agents function not only as BIM automation tools, but also as intelligent design assistants capable of supporting creative, analytical, and innovative architectural design development within the evolving context of digital architecture.

3.5 Analysis of the Potential and Challenges of AI Implementation in Architectural Design

The implementation and integration of AI agents within BIM-based architectural design workflows demonstrate significant potential in improving design efficiency, workflow optimization, and design exploration processes. Through integration with Autodesk Revit, AI agents enable users to automate repetitive modeling tasks, accelerate parameter adjustments, generate design alternatives, and support data-driven decision-making processes. The use of generative AI technologies also allows architects and designers to interact with BIM environments through natural language prompts, creating more adaptive and intelligent design workflows. In the context of architectural practice, this integration has the potential to reduce design time, improve productivity, and expand opportunities for conceptual exploration, particularly in digital and computational design environments.

However, despite its considerable potential, the implementation of AI within architectural design processes also presents several challenges and limitations. One of the primary challenges identified in this research relates to operational and subscription costs associated with generative AI platforms. In this study, the researchers predominantly utilized Groq due to its relatively accessible and free usage model, whereas Google Gemini and Claude were not fully implemented during the experimentation phase because of financial constraints related to API access and subscription fees. Although both platforms were successfully connected and technically integrated into the developed system architecture, their practical utilization within the research workflow remained limited. This condition highlights how economic factors can significantly influence the accessibility and scalability of AI integration within architectural research and professional practice.

In addition to financial limitations, hardware and computational requirements also represent major challenges in implementing AI-assisted BIM systems. The integration of AI agents with BIM environments requires devices with relatively high computational performance, including adequate processing power, memory capacity, and graphics capabilities to support real-time interaction, data processing, and model synchronization. Limited hardware specifications can reduce system responsiveness, slow down design operations, and affect the overall efficiency of the workflow. Furthermore, the implementation of AI in architecture also depends heavily on the availability of human resources with interdisciplinary competencies, particularly in architectural design, computational thinking, scripting, BIM workflows, and artificial intelligence integration. The lack of technical expertise and digital literacy among users may hinder the adoption and effective utilization of AI-assisted design systems.

Moreover, the rapid evolution of AI technologies presents additional challenges related to system adaptation, interoperability, data management, and long-term workflow integration within architectural practice. The inconsistency of AI-generated outputs, potential inaccuracies in generated design recommendations, and dependence on internet connectivity and cloud-based services also remain important considerations. Therefore, while AI implementation offers transformative opportunities for architectural design, its successful adoption requires balanced support in terms of infrastructure, funding, technical skills, and continuous technological development. This research demonstrates that the future integration of AI within BIM-based architectural design environments will not only depend on

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technological advancements, but also on economic accessibility, institutional readiness, and the development of adaptive human resources capable of operating within increasingly digital and intelligent design ecosystems.

4. CONCLUSION

This research demonstrates that the integration of AI agents within BIM-based architectural design environments has significant potential to enhance the efficiency, adaptability, and intelligence of contemporary architectural workflows. Through the development and integration of AI agents into Autodesk Revit 2021, the study shows that generative AI technologies can support various architectural design activities, including design exploration, parameter modification, spatial configuration, automated calculations, design ideation, and real-time interaction between users and BIM models. The integration with generative AI platforms such as Google Gemini, Claude, and Groq demonstrates the potential of AI-assisted systems to transform conventional BIM workflows into more interactive, responsive, and computationally driven design processes.

The findings also indicate that AI agents can function not only as BIM automation tools, but also as intelligent design assistants capable of supporting conceptual development, creative exploration, and performance-oriented design decision-making. The developed system enables users to utilize natural language prompts to perform architectural operations more efficiently, thereby simplifying complex modeling processes and reducing repetitive technical tasks. Furthermore, the integration approach explored in this study shows promising applications in both tropical architectural design and broader architectural contexts, including sustainable design strategies, façade development, spatial organization, and adaptive architectural concepts.

However, the research also identifies several important challenges affecting the implementation of AI within architectural design environments. Financial limitations associated with paid AI services, hardware and computational constraints, internet dependency, and the need for interdisciplinary human resources remain significant barriers to wider adoption. In this study, Groq was predominantly utilized due to its accessibility and relatively free usage model, while Google Gemini and Claude were only successfully integrated but not fully utilized because of subscription and operational cost limitations. These findings indicate that the future development of AI-assisted BIM systems requires not only technological innovation, but also greater accessibility, infrastructure readiness, and capacity building in computational and digital architectural skills.

Overall, this research contributes to the growing discourse on digital architecture and AI-assisted design by demonstrating the feasibility of integrating generative AI agents into BIM-based architectural workflows. The proposed approach highlights the potential for developing more intelligent, adaptive, and sustainable architectural design systems that can support future architectural practices in the era of computational and AI-driven design.

REFERENCES

Aalaei, M.R., Saadi, M., Rahbar, M., & Ekhlassi, A. (2023). Architectural layout generation using a graph-constrained conditional Generative Adversarial Network (GAN). Automation in Construction.

Choi, H. W., Jung, D. Y., Doseong, Y., Kim, M. S., & Kang, Y. T. (2024). Sorption thermal battery with solar powered absorption chiller for various building cooling applications. Energy and Buildings, 317, Article 114373. https://doi.org/10.1016/j.enbuild.2024.114373

DOI: http://doi.org/10.17509/jaz.v9i3.100705
p- ISSN 2621-1610 e- ISSN 2620-9934

Depari, A. S. (2025). Integrasi Parametric Design Dan Artificial Intelligence Untuk Keberlanjutan. *Membangun Melestarikan Bumi*, 193

Dong, Y., Zhan, Z., Hu, Y., Doe, D.M., & Han, Z. (2025). AI BIM coordinator for non-expert interaction in building design using LLM-driven multi-agent systems. Automation in Construction.

Erdiwansyah, Mamat, R., Rosdi, S.M., Rashid, M.I., Syahir, A., & Yusop, A.F. (2026). Thermal Energy Storage Innovations for Tropical Buildings Through Materials Integration and Smart Cooling Strategies. Sustainable Cities and Society: Advances.

Hu, Y., & Dossick, C.S. (2023). Decoding the dynamics of BIM use practice in construction projects. Construction Management and Economics, 42, 451 - 475.

Ibrahim, N. I., Yahiaoui, A., Garkuwa, J. A., Ben Mansour, R., & Rehman, S. (2024). Solar cooling with absorption chillers, thermal energy storage, and control strategies: A review. Journal of Energy Storage, 97, Article 112762. https://doi.org/10.1016/j.est.2024.112762

J. Manyika, M. Chui, M. Miremadi, J. Bughin, K. George, P. Willmott, M. Dewhurst, A future that works: AI, automation, employment, and productivity, McKinsey Global Institute, 2017. https://www.jbs.cam.ac.uk/wp-content/uploads/2020/08/170622-slides-manyika.pdf.

Jang, S., Roh, H., & Lee, G. (2025). Generative AI in architectural design: Application, data, and evaluation methods. Automation in Construction.

Jiang, Z., Xu, W., & Dong, B. (2026). An Agentic AI-Enabled Physics-Informed Machine Learning Framework for Grid-Interactive, Decarbonized Building Operations. Advances in Applied Energy.

Lecler, A., Duron, L., & Soyer, P. (2023). Revolutionizing radiology with GPT-based models: Current applications, future possibilities and limitations of ChatGPT. Diagnostic and interventional imaging.

Li, X., Wu, P., Shen, G.Q., Wang, X., & Teng, Y. (2017). Mapping the knowledge domains of Building Information Modeling (BIM): A bibliometric approach. Automation in Construction, 84, 195-206.

Sacks, R., Eastman, C., Lee, G., & Teicholz, P. (2018). *BIM handbook: A guide to building information modeling for owners, designers, engineers, contractors, and facility managers*. John Wiley & Sons.

Saka, A.B., Oyedele, L.O., Àkànbí, L.A., Ganiyu, S.A., Chan, D.W., & Bello, S.A. (2023). Conversational artificial intelligence in the AEC industry: A review of present status, challenges and opportunities. Adv. Eng. Informatics, 55, 101869.

Xin, Y., Zhou, Y., & Liu, Y. (2025). Prompts to layouts: Hybrid graph neural network and agent-based model for generative architectural design. Automation in Construction.

Yan, C., Abed, A. M., Chaturvedi, R., Dahari, M., Abdullaev, S., Zhou, X., Mahariq, I., & Elmasry, Y. (2024). Sustainable commercially-scaled greenhouse building cooling solution: Integrating PCM storage, desiccant wheels, and absorption chillers powered by dual-source solar/biomass energy. Journal of Energy Storage, 101, Article 113871. https://doi.org/10.1016/j.est.2024.113871

Yuan, P.F., He, Z., Li, J., & Xu, X. (2025). Spatial Semantic Information Model (SSIM): A Review for a Multi-dimensional Data Framework of AI-driven Architectural Design. Design Science Vision.

Yussuf, R.O., Asfour, O.S., (2024). Applications of artificial intelligence for energy efficiency throughout the building lifecycle: An overview. Energy and Buildings 305, 113903. https://doi.org/10.1016/j.enbuild.2024.113903

DOI: http://doi.org/10.17509/jaz.v9i3.100705
p- ISSN 2621-1610 e- ISSN 2620-9934

Tam, N.V., & Phong, V.V. (2026). Integrating generative AI and BIM for sustainable construction and built Environment: An AHP–DEMATEL-based strategic framework. Energy and Buildings.

Wei, Y., Li, X., & Petzold, F. (2025). Text-to-structure interpretation of user requests in BIM interaction. Automation in Construction.

Zheng, J., & Fischer, M. (2023). Dynamic prompt-based virtual assistant framework for BIM information search. Automation in Construction.

DOI: http://doi.org/10.17509/jaz.v9i3.100705
p- ISSN 2621-1610 e- ISSN 2620-9934