Examination of Putra Mosque's Visual and Architectural Cohesion: Engineering Design's Effect on Spatial and Functional Experience

Anfal A. Hamodat[1,2]* Dr. Mazlan M. Tahir[2]

[1] Department of Architecture, College of Engineering, University of Mosul, Mosul, Iraq.
Email: anfal.azzam@uomosul.edu.iq; p125157@siswa.ukm.edu.my (Corresponding Author)

[2] Department of Architecture, Faculty of Engineering and Built Environment,
Universiti Kebangsaan Malaysia (UKM), Bangi, Malaysia.
Email: p125157@siswa.ukm.edu.my

ABSTRACT:

Modern Islamic architecture like Malaysia's Putra Mosque combines traditional design with modern engineering, giving tourists and worshippers a unique spatial and psychological experience. This study evaluates the mosque's visual and architectural harmony and how engineering design affects space functioning, visual comfort, and user experience. Analytical descriptive methods are used to assess engineering distribution using Google Earth satellite imagery, structured questionnaires to gather visitor and doctoral student perceptions of spatial attributes, and systematic field observations to document visual-functional interactions. The relationships between architectural integration and user responses were examined using SPSS and Excel. Harmonious visual and architectural integration improves circulation between indoor and outdoor spaces, fosters harmony between natural and built elements, and increases spatial comfort through plentiful natural light, broad spaces, and gorgeous lake views, according to research. Soft colour palettes and natural features like water and wind boost mental and visual well-being. The study recommends integrating indoor and outdoor spaces, using more natural materials and lighting, and strengthening transitional zones to build sustainable, practical, and visually

harmonious environments. These findings help architects, engineers, and urban planners merge beauty, utility, and sustainability in modern mosques.

KEYWORDS: Architectural Cohesion, Putra Mosque, Spatial Functionality, Sustainable Mosque Design, Visual Integration.

INTRODUCTION:

One of Malaysia's most famous Islamic structures, the Putra Mosque mixes traditional and modern architecture. Shows in Figure 1, the mosque's exterior design must adapt to changing outdoor applications and rising visitor numbers. This study examines visual and architectural integration to create a spatial experience that promotes functional and aesthetic comfort.

Objectives: Learn design ideas that link adaptive landscapes and architectural blocks. Explore how visual and architectural integration affects user experience. Give practical suggestions to improve the mosques outside appearance.

Putrajaya's Putra Mosque is one of Malaysia's most famous urban monuments. Designed in the 1990s, this mosque opened in 1999. Malaysia's modern spirit and appreciation of Islamic heritage are reflected in the mosque's unique blend of Islamic and modern architecture. The Putra Mosque's stunning building combines Islamic and modern engineering. Malaysian mosques increasingly combine ethnic subcultures, international influences, and modern technology (Utaberta, 2020). The mosque is influenced by Turkish, Middle Eastern, and Northern African Islamic architecture. This is Islamic-inspired Malaysian mosque architecture. Malaysia becomes a top Islamic tourism destination with the Putra Mosque. Malaysia's architecture distinguishes it from Turkey and the UAE, traditional Islamic tourism destinations (Utaberta, 2020).

In the tranquil Lake District, the Putra mosque's modern Islamic style stands out in surroundings near the Prime Minister's home and Taman Botany Park. The mosque is part of a lakeside garden-surrounded cultural and religious complex that stretches to Dataran Potra. The region is beautiful and important for

tourism, and commercial tours allow visitors to see government and religious icons. Ferry services improve business and tourism by making work-home travel easier. This introduction explains how Putra Mosque fosters Malaysian religious architecture and culture (HKA SDN, 2001).

This project intends to examine how adaptable outdoor design might enhance public space engagement around the Putra Mosque, following the findings of Asif et al. (2018) and Asif et al. (2019). As noted by Ismail (2008), visual and environmental convenience declines with an increase in visits and variability in outdoor area usage, necessitating design solutions that address these challenges.

By deliberately integrating mosques and landscapes, visitors' visual and spatial experiences are enhanced. Architectural design supports cultural and religious variety and national unity in Indonesia, as shown by the Jakarta Independence Mosque and Independence Square (Aryanti & Achmadi, 2024).

The Farmin Grand Mosque in Iran uses geometric ornamental motifs to match modern urban environs and enhance its appearance (Nashalji & Saradj, 2024). Geometric forms, Arabic calligraphy, and rich embellishment are used in Islamic architecture. This holistic design approach integrates aesthetic and functional elements to create harmonious and sustainable spaces. Alhambra Palace in Granada, Spain, and Al-Azem Palace in Hama, Syria, are known for their Arabic calligraphy and ornamentation (Baydoun et al., 2024).

Islamic architecture promotes "unity of man with nature," a principle shared with Islamic philosophy (Chen & Wu, 2009; Umoh et al., 2024). Green spaces, water features, and natural materials are used in designs to create sustainable interactions between structures and their environment (Chen & Wu, 2009; Umoh et al., 2024).

The visual experience of mosques is influenced by the sensory impressions of visitors, where classic and modern designs provoke varied feelings, This is found in the Sangaklar mosque of Salimiya mosque in Turkey with its modern designs and new concepts that can have difficulty in achieving the goal of visitors accustomed to the traditional Islamic architecture style, so we find it important to fit the aesthetic designs

of the mosque with cultural and religious expectations to enhance the worshippers' emotional and spiritual experience (Hiçsönmezler et al., 2023).

The design of the mosque should usually give priority to spatial and volumetric models for resting worshippers, especially visual, while providing unimpeded viewpoints and promoting openness. Some studies have pointed to the importance of central domes in providing spiritual comfort according to spatial and volume (Ali & Mustafa, 2023) studies.

We also find the emphasis of contemporary European mosques on the relationship between identity, religion and passion in the design of mosques to reflect their traditional religious features with modern architectural trends in a balanced manner to reflect their content (Verkaaik, 2012).

Adaptive design in mosques and landscapes addresses environmental and social issues by improving interaction and complementarity between mosque architecture and surroundings. This approach integrates cultural, ecological, and social factors to create multifunctional landscapes that adapt to changing social values and environmental conditions, considering the complex interaction between human activities and biophysical processes that shape the landscape over time.

Adaptive design involves adapting construction sites to human needs, increasing landscape interaction, and incorporating local cultural and religious elements to reflect society's identity and values, including dynamic human-environment interactions (Adamolekun et al., 2024; Goryacheva et al., 2023). Plan and design the mosque and landscape with stakeholders and the community to meet their changing needs and promote social and cultural adaptation (Bartuszevige et al., 2016).

The Value of adaptable outdoor space design contained Adaptive design and Visual Balance the Adaptive design relates to outdoor spaces can be adapted to improve visual and functional connection with the main building while harmonizing natural and structural features. This method creates coherent, sustainable landscapes through environmental adaptation, functional balance, and sustainability.

Visual balance in adaptive design involves using biomimetic techniques to harmonize water and plants with architecture, creating a harmonious visual link between the structure and its environment (Badarnah, 2017; Hosseini et al., 2019). Contemporary architecture combines design and building to create beautiful, sustainable cities. Incorporating green constructions and preserving architectural features improves urban quality (Īle, 2021).

Outdoor spaces should guide activities and offer rest and relaxation to maintain functional balance. Effective spatial planning and environmental-responsive façade improve visual and thermal comfort (Hosseini et al., 2019; Wei et al., 2024).. Adaptive reuse aligns outdoor areas with the building's new use, improving accessibility and usability in historical buildings (Kıran Çakır et al., 2020).

The "space-based education" and "interdependent cultural landscape" ideas emphasize the importance of local context, cultural legacy, and environmental knowledge in influencing the built environment and integration with the surrounding landscape (Nikezić & Marković, 2015; Zhang & Li, 2024).

Deep sensory engagement with architectural and environmental components determines the aesthetic and exotic sense of visitors to mosques and the surrounding area and the perception of the landscape directly and indirectly enhances visitors' sense of renewal and belonging to the area by connecting with them while emphasizing the importance of the surrounding environment in improving the visitor experience (Li et al., 2023).

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The climate-adaptable outdoor spaces of Putra Mosque are ideal (Bahari & Said, 2011; Maarof, 2014). Lakes around mosques lower air temperature and improve local environment, and they can be used to construct Floating PV Systems to increase sustainable energy generation and reduce dependence on fossil fuels. Passive design includes natural ventilation, thermal insulation, direct solar illumination, thermal comfort, and energy conservation (Asif et al., 2019; Dini et al., 2023).

Additionally, the mosque's architecture balances privacy, visual beauty, and natural features to include Islamic precepts. These include geometric inscriptions and traditional Islamic themes to provide a spiritual visual experience that strengthens worshippers' psychological connection to space (Asif et al., 2019; Dini et al., 2023). The flexible mosque design emphasis's indoor-outdoor interaction, with covered corridors and green gardens encouraging natural flow and lowering heat (Azmi & Kandar, 2019).

Flooring and building orientation affect temperature and comfort inside and outside the mosque ((Sari et al., 2024). This framework emphasises the need for an interdisciplinary approach that integrates environmental, geographic, and architectural studies to generate holistic design strategies that combine natural and functional elements (Azmi & Kandar, 2019).

There are no data on how Putra Mosque implemented adaptive design solutions, but the context is greater awareness of sustainable and adaptive practices in outdoor space design (Bahari & Said, 2011;

Maarof, 2014). Cost, awareness, and stakeholder resistance may prevent these measures from being fully implemented.

In conclusion, Putra Mosque is a visual and environmental architectural paradigm that incorporates adaptable design, sustainable methods, and traditional Islamic values. The mosque becomes a civilization and environmental monument and an example for sustainable mosque architecture by improving thermal comfort, spatial experience, and carbon footprint.

Literature Review:

The Putra Mosque in Putrajaya, Malaysia, is a prominent example of integrated contemporary Islamic architecture. This literature analysis examines how Putra Mosque engineering design decisions affect users' spatial and functional experiences. The review synthesizes research on architectural immanency, place attachment, neurasthenics, and spatial analysis to understand how spatial organization, ornamentation, and structural engineering create a cohesive and meaningful worship and community gathering environment. Key studies emphasize the psychological impact of architectural coherence, emotional connection to place, and the blending of traditional and modern design concepts in achieving visual harmony and functional utility (Chatterjee et al., 2021; Nursanty & Husni, 2020). Standardized spatial experience metrics and the complex relationship between engineering and user perception are also lacking in the research. Over 170 million Consensus research publications, including Semantic Scholar and PubMed, were searched. The search approach focused on the Putra Mosque and targeted inquiries on visual and architectural harmony, engineering design, spatial experience, and mosque architecture. We identified 944 papers, reviewed 427, selected 171 for this study, and included 20 shows in Table 1. Eight search groups targeted mosque architectural core theories, engineering design, spatial analysis, embellishment, and user experience shows in Table 1.

Results:

- **Architectural Immanency and Place Attachment:** Mosque architecture research highlights the emotional and cultural links generated by tangible and intangible features that connect users to their religious and social identity. Like other award-winning mosques, the Putra Mosque uses inherited design aspects to generate a sense of belonging and spiritual connection, enhancing its community anchor function (Nursanty & Husni, 2020).
- **Visual Cohesion and Neuroaesthetics:** Architectural coherence, related to ease of organization and comprehension, strongly impacts user comfort and emotional valence. The Putra Mosque's harmonic blend of traditional Islamic themes and modern architectural concepts promotes visual comfort and excitement, improving the spatial experience (Chatterjee et al., 2021).
- **Engineering Design and Functional Experience:** Considerations including spatial arrangement, lighting, and structural health monitoring affect mosque interior usability and comfort. The Putra Mosque's open prayer hall, planned daylighting, and modern monitoring systems demonstrate how engineering can support ritual and social functions, assuring safety, accessibility, and adaptation (Abdulkarem et al., 2020).
- **Tradition-Innovation Integration:** Traditional Islamic architecture and modern engineering are balanced in the mosque's design. Ornamentation, spatial profiling, and circular design principles produce a unified and practical setting that blends ancient and modern sensibilities (Moreno et al., 2016; Nursanty & Husni, 2020). All results can be shown in Table 2, which lets us compare various important studies on the Putra Mosque's engineering design and how well its architecture and artwork together.

The literature review reveals that the Putra Mosque's architectural and engineering design promotes visual cohesiveness and functional excellence, supporting spiritual, emotional, and community demands. (Abdulkarem et al., 2020; Chatterjee et al., 2021; Nursanty & Husni, 2020) Using both old and new engineering techniques together makes a room that feels both real and flexible, which improves the user

experience and sense of place attachment. However, the research also shows that it can be hard to come up with standardized measures for space comfort and to find a balance between realism and new ideas (Moreno et al., 2016). Neuroaesthetic and environmental psychology points of view are becoming increasingly important. This means that when designing new mosques, they should consider both objective engineering criteria and subjective user experiences (Chatterjee et al., 2021). Shows in Table 3 the claim of Claims and Evidence.

According to literature, the Putra Mosque's engineering and architecture produces a visually appealing and functional atmosphere that supports spiritual and community experiences. Its success is due to its blend of traditional and modern aspects, spatial arrangement, and user comfort, although further research is needed to standardize assessment and explore psychological effects.

Research Gaps: Although progress has been made, spatial comfort measures, emotional and psychological implications, and modern technical technologies in mosque design are still lacking. Show gaps matrix in Table 4.

Future study should develop standardized instruments for analyzing spatial and visual comfort, examine mosque design's psychological effects, and integrate sophisticated engineering technologies for user experience. Table 5 explains why open research questions are important for future investigations.

In conclusion, the Putra Mosque exemplifies how precise engineering, and architectural design can create cohesive, practical, and significant places. This is further illustrated by the comparative insights presented in Table 6, where independent variables such as visual and architectural integration, exterior space design, and spatial orientation exhibit direct correlations with dependent variables including enhanced aesthetics, improved visual flow, and enriched user experience. Examples from prominent mosques like Sheikh Zayed, Hassan II, and Istqlal demonstrate the universal principles that improve the Putra Mosque's design efficacy and suggest areas where further research could improve assessment methodologies and deepen our understanding of the human spatial experience.

METHODS:

Methodology for Investigation:

This study evaluates how engineering, functional, and visual components affect the spatial experience at Malaysia's Putra Mosque using analytical descriptive methods. This method focuses on spatial integration to comprehend spatial, visual, and functional links utilizing quantitative and qualitative analysis.

Instruments for Data Acquisition:

Many tools are used to collect accurate and complete data:

- **Satellite imagery from Google Earth:** Check the geometry of roads, pathways, and outdoor spaces. Find internal-external transitions.
- **Online excursions**: Explore indoor-outdoor interaction. Explore engineering and visual direction virtually.
- **Questionnaire:** Legalized Likert Scale questionnaires were used. The questionnaire was provided to 50 visitors and graduate students. Essential themes were covered in the survey: Visual and architectural integration. Functional comfort. Natural light and warmth. Track and navigate well. Spiritual and psychological consequences of spaces.

Analyzing Data:

• Conduct quantitative analysis of questionnaire responses using SPSS and Excel. Identifying spatial experiment factors with PCA. We found 5 significant parameters explaining 60.8% of data variation.

• Qualitative Analysis: Enhance architectural-visual links through field observations.

Look at Google Earth tours.

Research Phase:

• **Phase I:** Engineering, Functional, and Visual Evaluation: Examine the primary dome, corridors, and fenestrations. Assess pathway and transition professional performance. Examine how windows and lake views connect the inside and exterior.

Second phase: Integration Create a framework for engineering, functional, and visual analysis. Harmonize elements for a unified and sustainable spatial experience. Analysis of design elements' visual and environmental consequences.

Analytical Pathway:

Collect field and virtual data (e.g., satellite pictures, virtual tours, surveys). SPSS/Excel quant tools. Field observations and virtual tours for qualitative data analysis. Analyze integration thoroughly. Comparing results to earlier studies for conclusions.

Concerns about ethics: Get participant consent before administering the questionnaire. Keep personal info private. Scientific research ethics compliance with international and institutional requirements.

RESULTS:

Engineered, functional, and visual analyses:

Balanced blocks and spaces. Direct spiritual and visual path to center dome. Harmonizes passageways and windows for indoor-outdoor flow.

- **Function Analysis:** Develop effective paths. Make shade breaks comfy. Functionally arrange areas.
- **Visual Analysis:** Lake vistas are enhanced by large windows. Dome axial elements focus optically. Visually balanced indoor and outdoor environments.
- **Integrating Analysis:** Merge engineering, functional, and visual factors for spatial experience. Balance the ecosystem with lakes and green spaces. Blend ventilation and natural light.

The engineering and architectural analysis of Putra Mosque shows how visual and architectural integration affects visitors' spatial and visual experiences. Table 5 shows the geometric and architectural consequences on the mosque's spatial and visual settings, explaining technology and architectural implications and proposing suggestions for improving indoor and outdoor spaces. Visual steering, functional sequencing, and interior-exterior sensory balancing improved performance and comfort.

Effective distribution and visual layout of dome, minarets, and corridors show the possibility for a linked spatial experience.

Analyzing the Putra Mosque's interior and exterior using 15 architectural and engineering integration features shows a balance between blocks, spaces, and proportions, with an emphasis on the main axis. Functional planning and attractive halls make the transition from outside spaces to the central prayer hall easy. Wide vistas and huge windows allow direct visual connection with the outside, strengthening the sense of connectedness with nature.

The study found that light and water create a cozy ambiance that improves visitor experience. The study proposed improving space connections, adding natural features, and creating paths for a more harmonic and comfortable experience.

Table 7 presents a detailed analysis utilizing satellite images from Google Earth, focusing on engineering, architectural, functional, and visual relationships. Table 7 illustrates the interaction between the main entrance, transitional corridors, large windows, and panoramic views with the ocean. Table 7 serves as a guide for improving movement flow and achieving visual balance within and around the mosque, thereby enhancing overall functionality and enriching the spatial experience for visitors.

Questionnaire:

- Data Source: A questionnaire was used to collect data on visual integration, design effect, natural lighting, mobility, and spiritual impact. This study examined the Putra Mosque's visual and spatial design and its impact on visitors. Strengths and weaknesses were identified using a 50-person questionnaire.
- Statistical Analysis Method: Identified important elements affecting various aspects by PCA.
- Eigenvalue and Scree Plot analysis identified five main components.

These factors explained 60.8% of the data variation, supporting a legitimate interpretation.

Findings and Implications:

- **Factor I:** Examines how visual and architectural design affects spatial experience. Lake interactions, design impacts, and optical integration. Variation is 15.9%. The element suggests that the mosque's landscape's visual and architectural interaction greatly affects visitors' spatial experience. Visuals should be improved for harmony. Enhance lake and landscape views.
- **Factor II:** Environment and natural lighting greatly impact functional comfort. Solar, fenestration, daylighting. Variation is 13.3%. Natural light and sunlight increase the mosque's appearance and comfort. Recommendations: Window redesign improves lighting. Control temperature and sunshine with current methods.
- **Factor III:** Seating comfort and natural surroundings Sitting comfort, plant influence, and shadowing comfort are linked. Variation ratio: 11.7%. Seating and plants are used to enhance the atmosphere. Provide visitor-friendly seating. Use vegetation and shadows.
- **Factor IV:** Mosque Mobility and Efficiency Transparent gearbox, easy navigation, and efficient paths. Variation ratio: 11.0%. This shows mosque movement efficiency, including signal clarity, route expansion, and accessibility. Mosque signage improvements are advised. Optimize route capacity and reduce obstacles.
- **Factor V:** Spiritual and emotional impact on guests. Spiritual impact met wants. Variance is 8.9%. This represents the visitor's spiritual experience and the mosque's ability to meet their demands. Suggestions: Create a spiritual atmosphere with soft lights. Provide illumination and rest spots. Total explanatory variation is the proportion of dependent variable volatility accounted for by independent variables in a statistical model. Total interpreted variation is 60.8%. The five criteria explain most data discrepancies, supporting evidence-based decision-making.

General Questionnaire conclusion:

- Visual and architectural integration is a significant component of the visitor experience.
- Natural lighting is crucial for visual and environmental comfort.

- Comfortable seats and shaded places impact visitor happiness.
- Efficient navigation: Unobstructed pathways facilitate a seamless experience.
- The interplay of lighting and minimal requirements influences spirituality.
- Enhance visual and architectural integration to achieve external harmony.
- Enhance visual acuity through exposure to natural light.
- Enhance the utilization of plant shade.
- Clear indicators facilitate internal mobility.
- Serene design and comfortable amenities facilitate spiritual experiences.

DISCUSSION:

Analysis reveals Putra Mosque's design promotes visitors' spiritual experience through natural lighting, shaded places, and integration with the surrounding environment. Movement management at busy moments, visibility of indoor-outdoor transitions, and the lack of rest stops at key spots have been major difficulties.

The findings related visual pleasure and effortless mobility. Transfer efficiency and visibility boost visitors' architectural design satisfaction. However, corridor congestion and insufficient lighting decreased pleasure.

The mosque is physically and functionally appealing, but improving traffic management, transfer visibility, and break points can improve spatial and visual integration and visitor comfort.

- **Obstacles:**
  - **Operational costs and ongoing maintenance:** Sustaining the mosque's operational and aesthetic performance necessitates enduring financial and administrative resources.
  - **Heightened awareness of the significance of integrated design:** Maintenance providers may struggle to comprehend architectural features and their practical purposes.

- **Environmental impact:** It is essential to guarantee the sustainability of natural and lacustrine regions while mitigating the adverse effects of human activities.

Future Directions:

- Develop intelligent lighting and adaptation systems tailored to local climatic circumstances.
- Promote ongoing study on the integration of indoor and outdoor environments in places of worship.
- Utilization of sustainable building materials that enhance the mosque's thermal and aesthetic performance.

This discussion elucidates that Putra Mosque exemplifies a modern architectural paradigm that harmonizes natural, functional, and engineering components. This mosque serves as a design reference applicable to analogous constructions, not alone within the Muslim world but also on a global scale.

Recommendations:

- Promote integration of indoor and outdoor spaces to improve user experience.
- Increased reliance on smart technologies for energy and lighting management.
- Develop specialized training programs for mosque maintenance and operation teams.
- Implementing Putra Mosque-inspired pilot programs in other places for greater investigation of results.

To accomplish sustainable design and improve users' spatial experience, the study emphasizes balancing architectural aesthetics with practical and environmental needs. This study provides a platform for future design initiatives.

DATA AVAILABILITY STATEMENT:

The search included this study's Google Earth picture analysis. Participants completed surveys, and the research included statistical analysis of these questions. Complete questionnaire questions were not included. Request the detailed questionnaire questions from the author responsible.

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TABLES:

449 **Table 1.** Literature search and selection flow diagram

Identification	Screening	Eligibility	Included
944	427	171	20

450 **Table 2.** Comparing Putra Mosque engineering design and visual and architectural cohesion

Paper	Methodology	Focus	Key Results	Sample/Context
(Nursanty & Husni, 2020)	Qualitative, case study	Place attachment, architectural immanency	Identifies emotional and cultural bonds via inherited design elements	Aga Khan Award-winning mosques, including Putra Mosque
(Chatterjee et al., 2021)	Psychometric & fMRI analysis	Neurasthenics, spatial experience	Finding coherence, fascination, and hominess as key to positive experience	Architectural interiors, including religious spaces
(Abdulkarem et al., 2020)	Review	Structural health monitoring	Highlights engineering's role in safety and adaptability	Structural monitoring in public buildings
(Moreno et al., 2016)	Systematic review	Circular design in architecture	Recommends holistic, sustainable design strategies	Architectural design frameworks

451 **Table 3.** These studies' main arguments and proof

Claim	Evidence Strength	Reasoning	Papers

Engineering improves mosque space and function	Strong evidence (9/10).	Study after study shows that spatial organization, lighting, and monitoring improve usability and comfort.	(Abdulkarem et al., 2020; Chatterjee et al., 2021; Nursanty & Husni, 2020)
Architectural cohesion creates spiritual and emotional bonding	Evidence strength: Strong (8/10)	Qualitative and case studies link design inheritance to location attachment.	(Nursanty & Husni, 2020)
Successful mosque design combines tradition and innovation	Evidence strength: Moderate (7/10)	Reviews and case studies show that mixing old and new works.	(Moreno et al., 2016; Nursanty & Husni, 2020)
User experience is shaped by Neuroaesthetic elements (coherence, interest)	Evidence strength: Moderate (7/10)	Psychometric and fMRI research show visual harmony's impact.	(Chatterjee et al., 2021)
Standardized spatial comfort measurements are absent	Evidence strength: Moderate (4/10)	Literature calls for more consistent assessment tools.	(Chatterjee et al., 2021; Moreno et al., 2016)
Excessive embellishment might compromise authenticity	Evidence strength: Weak (3/10)	Some critics say modern decoration may inspire copying.	(Nursanty & Husni, 2020)

452 **Table 4.** Topic and study attribute research coverage and gaps matrix

Topic/Attribute	Traditional Design	Modern Engineering	User Experience	Ornamentation	Monitoring Tech
Place Attachment	3	1	2	2	GAP
Visual Cohesion	2	2	2	1	GAP
Functional Experience	1	3	2	GAP	2
Neuroaesthetics	GAP	1	2	GAP	GAP
Standardized Metrics	GAP	GAP	1	GAP	GAP

453 **Table 5.** Open research issues and their relevance to future studies

Question	Why
Can mosque architecture's spatial and visual comfort parameters be standardized and validated?	Standardized tools are needed to properly compare mosque designs' user experience.
Architectural cohesiveness in religious spaces: psychological and Neuroaesthetic effects?	Understanding these effects can help build spiritual and emotional well-being solutions.
How may modern engineering be used in mosque design without compromising authenticity?	Creating functional and culturally relevant environments requires balancing innovation and tradition.

454 **Table 6.** Previous project examples are used to summaries independent-follow-up variable relationships

455 in the table

Independent Variable	Dependent Variable	Relationship Explanation	Example (Example)
Visual and Architectural Integration	Enhancement of Architectural Aesthetics	The integration of visual and architectural elements contributes to a harmonious design that enhances the mosque's architectural identity.	At Sheikh Zayed Mosque, visual and engineering elements were combined to create a unique harmonious and aesthetic design.
Outer Space Design	Improved Visual Flow	The thoughtful design of outdoor spaces helps achieve a clear vision of spaces and enhances the visual interconnectedness between inside and outside.	At Hassan II Mosque, outdoor squares are designed to allow a smooth visual flow towards the sea.
Spatial Experience	Enhancement of User Experience	Good spatial design contributes to creating a comfortable and clear experience for users through the thoughtful distribution of spaces.	In the Istlel mosque, indoor and outdoor spaces are designed to promote functional and visual comfort.
Spatial Orientation	Improvement of movement inside and outside the mosque (Improve Spatial Circulation)	Thoughtful spatial guidance allows smooth and effective movement between different spaces inside and outside the mosque.	At the Istlel mosque, good guidance facilitates the movement of worshippers and avoids congestion.

Independent Variable	Dependent Variable	Relationship Explanation	Example (Example)
Visual Sequencing	Enhancing Visual Focus	The thoughtful visual sequence contributes to the visitor's attention to the main focal points of the mosque.	At the Putra Mosque, the visual gradient from the outside walkways to the prayer hall helps to focus attention on the bayonet.
Decorative Elements	Achieving a distinctive architectural identity	Decorative elements, such as inscriptions and Arabic lines, promote the mosque's cultural and architectural identity.	In the Sheikh Zayed Mosque, Islamic motifs were harmoniously integrated into walls and ceilings.
Space Coordination	Enhance Functional Use	The thoughtful distribution of spaces supports the mosque's different uses without functional overlap.	In Istkel mosque, halls and corridors were distributed

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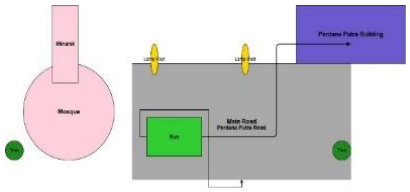
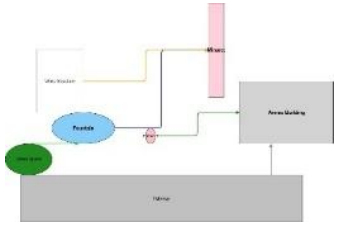
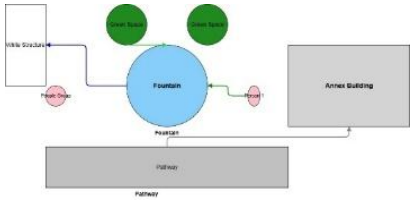
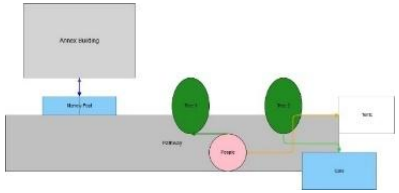
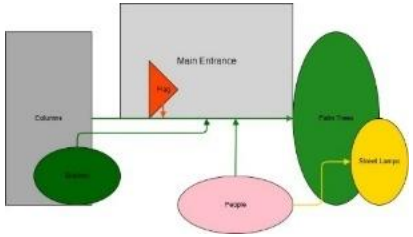
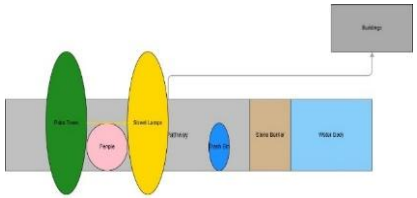
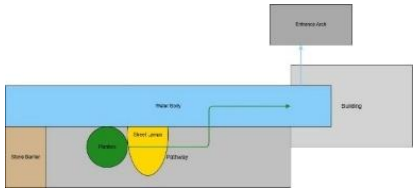
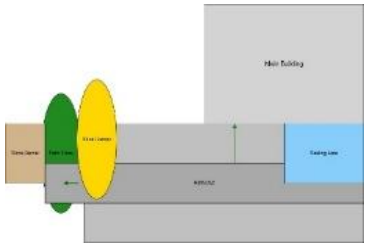
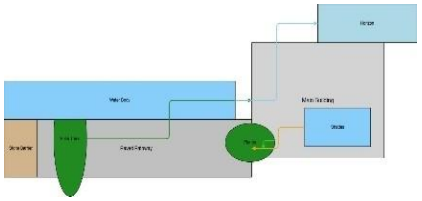
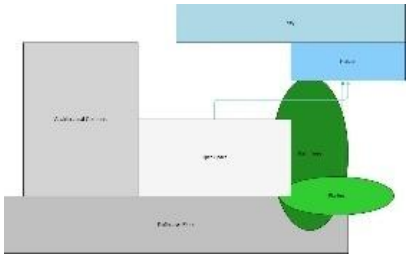
457 **Table 7.** Google earth-based engineering, visual, and functional analysis of Putra Mosque elements: integrative relationships

Google Earth Virtual Exploration		**Geometric Relationships**	**Functional Analysis**	**Visual Analysis**	**Integrative Analysis**
Main Entrance of the Mosque			A pivotal geometric design that directs movement towards the main entrance.	Smooth movement flows from the outdoor arena to the inside.	A clear visual line that draws attention to the main dome.
View Towards the Lake			Direct visual connection between tracks and lake through open design.	Easy access to waterfront.	Water reflections add visual dimensions.

Google Earth Virtual Exploration		Geometric Relationships	Functional Analysis	Visual Analysis	Integrative Analysis
External Plaza			Geometric balance between major blocks and external spaces.	Accurate regulation of movement paths between squares.	Visual orientation towards key points.
Interior Corridors			Corridors link the internal and external spaces seamlessly.	Regulate the flow of users across spaces.	Promote natural light through open passages.

Google Earth Virtual Exploration		Geometric Relationships	Functional Analysis	Visual Analysis	Integrative Analysis
Large Windows Overlooking the Lake			Direct large windows towards the lake to achieve visual integration.	Provide effective natural ventilation.	A direct view of the lake inside.
Transitional Pathways			A pivotal distribution identifying key points of transmission between spaces.	Central crossing points facilitate movement.	Optical focus on axial elements.

Google Earth Virtual Exploration		Geometric Relationships	Functional Analysis	Visual Analysis	Integrative Analysis
Green Spaces Integration			Harmonious geometric distribution between green squares and corridors.	Hierarchy of movement towards the main arenas.	A clear view of the green spaces.
Corridors and Natural Ventilation			Openings strike a balance between inside and outside and air flow.	Improve internal ventilation and thermal comfort.	Visual association with surrounding natural elements.

Google Earth Virtual Exploration		Geometric Relationships	Functional Analysis	Visual Analysis	Integrative Analysis
Panoramic Viewpoint			A pivotal relationship between internal spaces and external views.	Smooth flows between squares and inside.	Promote natural lighting and visual transparency.
Open Pathways to the Horizon			Geometric repetition of columns achieves visual and logical continuity.	The corridor acts as a flexible transition zone linking indoor and	Direct views of the lake offer a quiet visual experience.

Google Earth Virtual Exploration		Geometric Relationships	Functional Analysis	Visual Analysis	Integrative Analysis
				outdoor spaces.	

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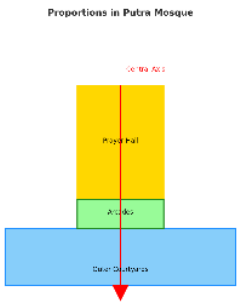
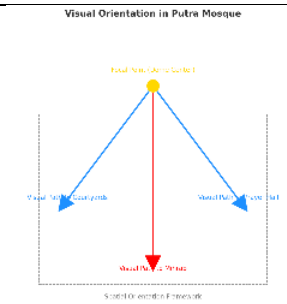
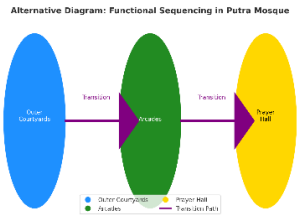
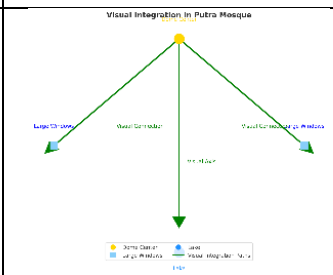
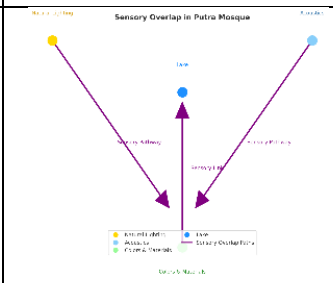
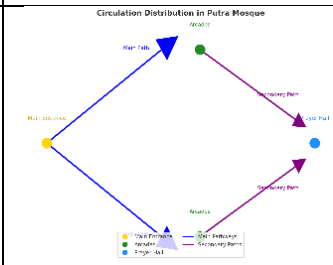
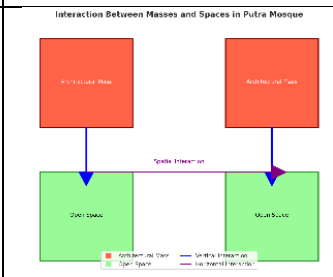
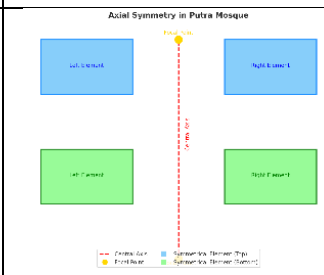
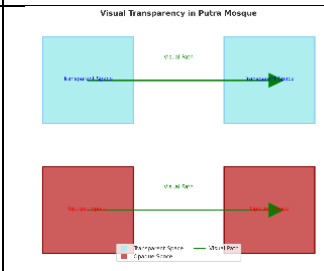
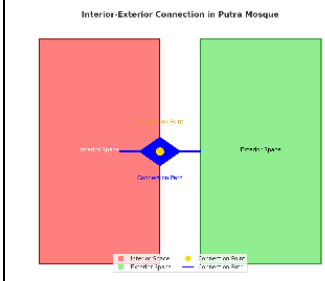
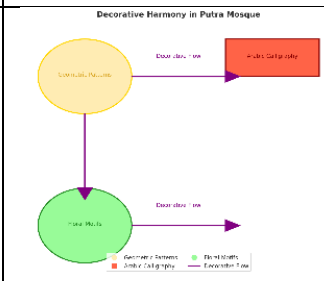
459 **Table 8.** Analysis of technical and architectural features and their effects on Putra mosque's spatial and

460 visual experience with recommendations

Analytical component		**Design and Engineering Description**	**Results**	**Suggestions**
Engineering Pedigree (Proportions)		Balance the building's vertical and horizontal dimensions while maintaining crucial symmetry.	Achieve visual balance and clarity in the distribution of spaces.	Promote balance between blocks and spaces.
Visual Orientation		Use of dome and minarets as key guiding elements.	Visibility towards key spaces.	Enhance optical signals at transit points.
Functional Sequencing		Logical arrangement of spaces from outdoor squares towards the prayer hall.	Smooth and tidy transmission without congestion.	Add break points in the main tracks.

Analytical component		Design and Engineering Description	Results	Suggestions
Visual Integration		Use large windows and brackets to achieve visual continuity.	Natural visual connection between inside and outside.	Increase optical binding openings.
Sensory Overlap		Use natural lighting, quiet colors and water bodies.	Promote psychological and visual comfort.	Integrate additional natural elements.
Circulation Distribution		Clear main and sub-tracks that facilitate mobility.	Clarity of movement flows without hindrance.	Improve indicative marks.
Interaction between Masses and Spaces		A balanced relationship between open and closed spaces.	Successful blending between hard blocks and open spaces.	Improved use of outdoor squares.

Analytical component		Design and Engineering Description	Results	Suggestions
Axial Symmetry		Relying on a main axis connecting indoor and outdoor spaces.	The clarity of the belligerent orientation.	Support axes with additional visual elements.
Visual Transparency		Use glass and large windows to achieve visual transparency.	Clarity of communication between spaces.	Enhancing transparency in transition points.
Interior-Exterior Connection		Clear transmission points between spaces across arcades and corridors.	Functional and visual continuity.	Enhance the design of transitional splicing points.
Decorative Harmony		Use harmonious recurrent decorative patterns.	Unifying the mosque's architectural identity.	Preserve traditional elements.

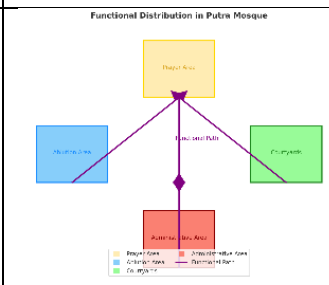
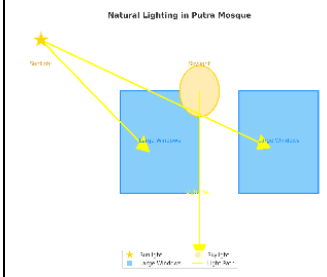
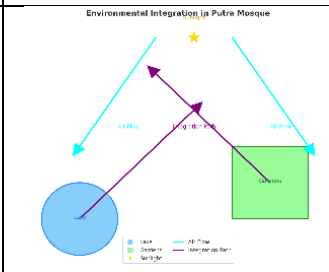
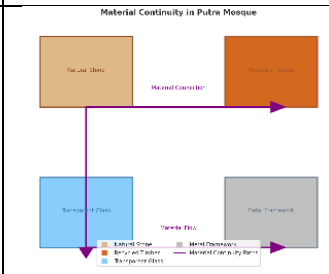
Analytical component		Design and Engineering Description	Results	Suggestions
Functional Distribution		Define clear functions for each space (prayer, meditation, transit).	High efficiency in the use of blanks.	Improve the distribution of break points.
Lighting		Relying on overhead openings and large windows.	Balanced lighting inside the prayer hall.	Increase overhead openings to improve lighting.
Environmental Integration		Using the lake as a natural element promotes visual comfort.	Reduce heat and achieve environmental balance.	Increase green spaces.
Material Continuity		Use uniform building materials at home and abroad.	Achieve visual and physical continuity.	Maintain the consistency of materials across spaces.

FIGURE CAPTION LIST:

463 **Fig. 1.** (a) Putra Mosque (Khan et al., 2020) (b) Equipment location at Putra Mosque (Ariff et al., 2012) (c)

464 Natural roof lighting Masjid Putra (Utaberta, 2020)