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**Research Article**

# SHARIA-COMPLIANT CIVIL ENGINEERING: A STUDY ON THE DESIGN OF GENDER-SEPARATE FACILITIES IN PUBLIC TRANSPORTATION HUBS

Amelia Hayati[1], Dian Popi Oktari[2], and Mukhtar Lutfie[3]
[1] Universitas Padjadjaran, Indonesia
[2] Sekolah Tinggi Ilmu Tarbiyah Nahdlatul Ulama Sumber Agung OKU Timur, Indonesia
[3] Universitas Muhammadiyah Luwuk, Indonesia

**Corresponding Author:**

Amelia Hayati,
Department of Islamic Economic, Faculty of Economic and Business, Universitas Padjadjaran.
Jalan Raya Bandung Sumedang KM 21 Jatinangor, Kab. Sumedang, Prov. Jawa Barat, Indonesia
Email: amelia.hayati@unpad.ac.id

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## Abstract

The growing demand for infrastructure that aligns with Islamic ethical and social values has encouraged the integration of Sharia-compliant principles into modern civil engineering practices. Public transportation hubs, as shared urban spaces, present unique challenges in maintaining both efficiency and modesty, particularly regarding gender interaction. This study aims to examine the design and implementation of gender-separate facilities in public transportation hubs through a Sharia-compliant civil engineering perspective. The research employs a mixed-methods approach, combining qualitative content analysis of Islamic legal sources (fiqh al-'imarah and maqasid al-shariah) with quantitative evaluation of design efficiency and user satisfaction from three case studies: Jakarta MRT, Kuala Lumpur Sentral, and Doha Metro. The findings reveal that gender-segregated layouts, when integrated with universal design principles, enhance both comfort and privacy without reducing operational capacity. The study also identifies key design variables—such as spatial zoning, circulation flow, and signage systems—that ensure compliance while maintaining inclusivity. The results emphasize that ethical urban design grounded in Sharia principles can coexist with modern engineering standards, promoting cultural sensitivity, sustainability, and social harmony.

**Keywords:** Civil Engineering Ethics, Islamic Urban Planning, Sharia-Compliant Design



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## INTRODUCTION

Urban transportation hubs such as metro stations, bus terminals, and airports have evolved into complex public infrastructures that not only serve mobility but also reflect the cultural, ethical, and social identity of a society (S. Li et al., 2024; J. Wang et al., 2025). In predominantly Muslim countries, where Islamic norms govern various aspects of life, civil engineering and architectural design are increasingly expected to reflect the principles of Sharia compliance. These principles extend beyond religious symbolism; they encompass spatial ethics, environmental stewardship, and human dignity (Nejadshamsi et al., 2025). One of the most visible manifestations of Sharia-compliant design is the provision of gender-separate facilities spaces that respect the Islamic value of modesty (haya') while ensuring functionality and inclusivity in public environments. Such a design philosophy integrates religious ethics into practical engineering solutions, redefining the relationship between cultural identity and modern infrastructure (Cen et al., 2025; Wu et al., 2025).

The growing urbanization in Muslim-majority cities has intensified the need for transportation hubs that accommodate millions of passengers daily, often from diverse cultural and religious backgrounds (Zuo et al., 2023). The design of these spaces must balance efficiency, accessibility, and respect for social norms. Islamic ethics emphasize gender interaction boundaries in public spaces to preserve moral integrity and personal comfort (Yang et al., 2024). However, most modern design frameworks, influenced by secular planning traditions, prioritize universal accessibility without considering the spiritual or social sensitivities of users (Su et al., 2025). This disconnect creates a challenge for engineers and planners seeking to implement Sharia-compliant civil engineering principles within global design standards, such as ISO 21542 on accessibility or LEED sustainability criteria. The growing discourse on "ethical infrastructure" highlights the need to integrate faith-based perspectives into civil engineering practice without compromising technological innovation or efficiency (Boutarfa & Gök, 2023).

The alignment between Islamic jurisprudence (fiqh al-'imarah) and civil engineering design principles represents an emerging interdisciplinary field that redefines the ethical dimension of urban construction (Liu, 2023). The Quranic values of balance (mizan), cleanliness (taharah), and modesty (haya') provide a moral foundation that can guide engineers in creating socially sustainable environments. In the context of public transportation hubs, gender-separate facilities such as waiting areas, ticketing zones, restrooms, and prayer rooms embody the integration of spiritual values into functional infrastructure (Xie et al., 2025). This study situates itself within this broader framework, acknowledging that Sharia-compliant design is not merely a cultural expression but a systematic approach to ensuring dignity, safety, and equity in public spaces (Meshkani et al., 2024).

The central problem addressed in this study lies in the lack of integrated Sharia-compliant frameworks within the design of public transportation hubs in Muslim-majority regions (Kelly et al., 2025). Despite the growth of Islamic urbanism and the recognition of cultural sensitivity in global architecture, the actual implementation of gender-separate design principles remains inconsistent, fragmented, and often symbolic rather than functional. Many modern transportation facilities prioritize operational efficiency and aesthetic modernity, yet fail to accommodate the sociocultural requirements of Muslim users (Bulková et al., 2025; Huang et al., 2023). In cities like Jakarta, Kuala Lumpur, and Doha, there have been ongoing debates regarding how to reconcile modern engineering standards with Islamic moral obligations, particularly in spaces where gender interaction is unavoidable. This gap between religious ethics and engineering practice has led to dissatisfaction among users, particularly women, who experience discomfort in overcrowded, gender-mixed environments (Y. Zhang et al., 2023).

The problem further extends to the absence of standardized design guidelines that translate Sharia principles into measurable engineering criteria (Tian et al., 2024). While

Islamic jurisprudence provides broad ethical injunctions regarding modesty and privacy, civil engineering requires quantifiable parameters for space allocation, material selection, and circulation flow (Zeng et al., 2023). This disconnect creates ambiguity for engineers who wish to adhere to Islamic values but lack clear technical references. The result is often an inconsistent implementation of gender-separate facilities some overly segregated, limiting accessibility, while others are superficially labeled as "Sharia-compliant" without functional justification. Such inconsistencies not only undermine public acceptance but also hinder the global credibility of Sharia-compliant infrastructure design (Awwaad et al., 2024).

The lack of user-centered evaluation mechanisms in Sharia-compliant facility design compounds the issue (Jiang et al., 2025). Current transportation systems rarely incorporate structured feedback from passengers regarding comfort, privacy, or spiritual satisfaction. Consequently, engineers and policymakers remain uncertain whether gender-separate designs genuinely enhance user experience or merely serve as cultural tokenism (Ke et al., 2024). The absence of empirical assessment frameworks limits the capacity to evaluate the effectiveness of these designs within operational and ethical parameters. This study responds to these gaps by proposing an analytical model that bridges theological interpretation with engineering practice through empirical validation in real-world settings (J. Wang et al., 2023).

This study aims to explore and evaluate the implementation of Sharia-compliant design principles in the development of gender-separate facilities within public transportation hubs (X. Guo et al., 2025). The primary objective is to identify how Islamic ethical norms derived from maqasid al-shariah (objectives of Islamic law) can be systematically integrated into civil engineering design without compromising efficiency, safety, and inclusivity (Al-Oraiqat et al., 2025). The research focuses on how design configurations can uphold the principles of modesty and privacy while maintaining the smooth circulation and accessibility required in high-density transit environments (R. Zhou et al., 2025).

Another objective of this study is to develop a conceptual framework that translates qualitative Islamic values into quantitative engineering parameters. The research investigates the relationship between ethical design components such as visual privacy, spatial zoning, and user flow and their impact on operational performance and user satisfaction. By employing a mixed-methods approach combining qualitative content analysis and quantitative case evaluations, the study seeks to formulate practical guidelines for engineers, architects, and urban planners involved in the design of Sharia-compliant facilities (Hassan et al., 2025).

The final objective is to provide policy and design recommendations for urban infrastructure authorities and transportation agencies. The proposed framework aims to contribute to international best practices in ethical engineering by demonstrating how religious values can be aligned with universal standards of sustainability, accessibility, and safety. Through empirical evidence from case studies in Jakarta, Kuala Lumpur, and Doha, this research intends to demonstrate that integrating Sharia-compliant principles can improve both user comfort and operational integrity, offering a replicable model for other Muslim and multicultural cities.

Existing literature on Sharia-compliant urban design remains largely concentrated in the fields of Islamic architecture and urban sociology, with limited contributions from civil engineering perspectives. Most previous studies have focused on mosque architecture, Islamic housing, or heritage conservation, leaving public transportation infrastructure relatively underexplored. Research addressing gender separation in public facilities often adopts a moral or sociological lens without grounding its findings in technical feasibility or design performance. This gap underscores the necessity of interdisciplinary research that bridges theological understanding and engineering application.

While a few recent works have examined the concept of Sharia compliance in urban development, they lack comprehensive methodologies for integrating ethical principles into quantitative design metrics. Studies by (Z. Li et al., 2025) and (J. Yu et al., 2025) proposed

conceptual frameworks for Islamic architecture but stopped short of developing measurable models for civil infrastructure. No existing study has systematically analyzed the operational impact of gender-separate layouts on public transportation hubs, particularly in terms of flow optimization, spatial efficiency, and user perception. The absence of such data-driven evaluation mechanisms limits policymakers and engineers from adopting Sharia-compliant practices confidently in public transport contexts.

Furthermore, there is an evident gap between policy rhetoric and implementation. Many municipalities in Muslim-majority cities have declared intentions to promote Islamic urbanism yet lack institutional mechanisms to enforce these principles in civil engineering projects. In the absence of standard performance indicators, Sharia-compliant design often remains a symbolic label rather than a functional system. This study seeks to fill this gap by integrating theological values with engineering science through empirical validation, thereby contributing both theoretical depth and practical applicability to the discourse on Islamic infrastructure development.

The novelty of this research lies in its engineering-oriented interpretation of Sharia-compliant design, positioning Islamic ethical principles within the empirical and technical framework of civil engineering. Unlike previous studies that primarily discuss religious or aesthetic dimensions, this research operationalizes Sharia values into measurable engineering variables such as spatial flow efficiency, user privacy indices, and environmental sustainability. The integration of Islamic jurisprudence with engineering modeling introduces a new interdisciplinary paradigm Sharia-compliant civil engineering that connects moral philosophy with practical urban design. This methodological innovation enables a transition from normative discourse to evidence-based implementation.

The justification for this research is grounded in the increasing global recognition of faith-based ethical engineering as part of sustainable development. International standards such as the UN's Sustainable Development Goals (SDGs) and the Islamic Development Bank's (IsDB) framework for ethical infrastructure highlight the necessity of aligning cultural and spiritual values with technological advancement. This study contributes to that alignment by demonstrating how Sharia-compliant design principles can serve as a foundation for socially inclusive and ethically responsible engineering practices. The focus on gender-separate facilities also responds to contemporary debates about women's comfort and safety in public spaces, positioning Islamic ethics as a proactive rather than restrictive framework for design innovation.

The contribution of this study extends beyond academic inquiry to practical policy relevance. By introducing a validated framework for gender-separate facility design, the research provides actionable insights for transportation authorities, urban planners, and civil engineers in Muslim-majority and multicultural cities. The study also establishes a reference point for integrating cultural ethics into global engineering standards, illustrating that religiously grounded design can coexist with universal modernity. This innovative intersection of faith and functionality marks a significant contribution to both the literature on civil engineering ethics and the evolution of Sharia-compliant urban infrastructure.

## RESEARCH METHOD

### *Research Design*

This study used a mixed-methods design combining both qualitative and quantitative approaches to thoroughly investigate the implementation of Sharia-compliant principles in gender-separate facilities design within public transportation hubs (Rifan et al., 2023). It followed a sequential structure starting with conceptual mapping, then empirical validation, and finally a comparative evaluation across case studies. The design integrated normative

Islamic principles with measurable engineering performance indicators to ensure both theological soundness and technical reliability (Y. Zhang et al., 2025).

### *Research Target/Subject*

The research targeted users and professionals involved in the design, management, and operation of public transportation hubs in three Muslim-majority cities: Jakarta (Indonesia), Kuala Lumpur (Malaysia), and Doha (Qatar). The sample consisted of 450 respondents, divided into 300 public transport users (evenly split by gender) and 150 professionals including architects, civil engineers, and transport planners (Z. Wang et al., 2025). Stratified random sampling ensured representation across gender, occupation, and cultural background. Case studies were selected based on criteria such as the presence of gender-separate facilities, operational maturity over three years, and available design documentation.

### *Research Procedure*

The study proceeded in four systematic phases: conceptual, analytical, empirical, and evaluative. The conceptual phase involved reviewing Islamic legal texts, maqasid al-shariah ethical principles, and modern engineering codes to develop a theoretical framework for Sharia-compliant design. The analytical phase identified relevant spatial and social variables such as visual privacy, circulation flow, and accessibility concerning gender segregation (H. Yu et al., 2024). Empirical data collection occurred through field visits, surveys of users, and interviews with professionals, supplemented by observational checklists and spatial mapping of environmental and behavioral patterns. Finally, the evaluative phase integrated qualitative and quantitative results through triangulation to compare religious principles with practical implementations. Ethical approval and informed consent were secured (Liao et al., 2025).

### *Instruments, and Data Collection Techniques*

Three primary instruments were employed: a semi-structured interview guide used with professionals to explore design rationale and regulations; a structured questionnaire administered to public users measuring satisfaction, comfort, privacy, and efficiency on a 5-point Likert scale; and technical tools including AutoCAD-based space utilization analysis and GIS mapping for circulation efficiency and zoning evaluations. The survey instrument showed strong reliability with a Cronbach's alpha of 0.89, while validity was ensured via expert reviews by specialists in Islamic urban design and transportation engineering (R. Zhang & Kontou, 2025).

### *Data Analysis Technique*

Data analysis combined qualitative and quantitative methods. Qualitative data underwent thematic coding to extract recurring design patterns and challenges from interviews and document analyses. Quantitative survey data were examined using descriptive statistics and cross-tabulation to assess user satisfaction and functionality. Spatial data from mapping tools were analyzed for circulation efficiency and spatial zoning. Triangulation of these methods allowed a comprehensive evaluation of Sharia-compliant facility design grounded in both theological and engineering perspectives (Hou et al., 2023).

## RESULTS AND DISCUSSION

The research produced a comprehensive dataset drawn from three major public transportation hubs: Jakarta MRT (Indonesia), Kuala Lumpur Sentral (Malaysia), and Doha Metro (Qatar). Quantitative data were obtained from 450 respondents, consisting of 300 public transport users and 150 professionals involved in urban planning and civil engineering. The demographic distribution of respondents demonstrated balanced gender representation and a wide age range between 21 and 60 years. Descriptive statistics indicate that 78% of users

acknowledged awareness of gender-separate facilities, while 65% considered them necessary for ensuring comfort and modesty in public environments. Table 1 summarizes key statistical indicators relevant to user satisfaction, privacy perception, and facility accessibility in the selected case studies.

**Table 1.** Descriptive Statistics of User Perceptions on Gender-Separate Facilities in Transportation Hubs (N = 450)

| Variable | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|
| User Satisfaction | 2.4 | 5.0 | 4.21 | 0.54 |
| Privacy Perception | 2.8 | 5.0 | 4.36 | 0.47 |
| Accessibility Ease | 2.0 | 5.0 | 4.08 | 0.63 |
| Cultural Compatibility | 3.0 | 5.0 | 4.49 | 0.39 |
| Spatial Comfort | 2.5 | 5.0 | 4.18 | 0.57 |

The data reveal consistently high mean values across all variables, suggesting positive public reception toward gender-separate design initiatives. Respondents rated cultural compatibility as the highest variable (M = 4.49), indicating strong alignment between design and Islamic ethical norms. Privacy perception followed closely, reflecting that well-structured zoning and visual barriers significantly enhance user comfort. Conversely, accessibility recorded slightly lower means (M = 4.08), implying that while gender separation enhances comfort, it may pose challenges to universal mobility in densely crowded transit areas. The low standard deviations (ranging from 0.39 to 0.63) indicate uniformity in user responses across regions, underscoring consistent expectations among Muslim-majority populations.

The explanatory analysis highlights that gender-sensitive spatial planning positively affects perceived satisfaction and cultural comfort in transportation hubs. Facilities that incorporate clear signage, designated waiting areas, and partitioned entry points demonstrated higher satisfaction scores compared to those without structured segregation. The correlation between privacy perception and user satisfaction was notably strong ($r = 0.82$, $p < 0.01$), validating the hypothesis that visual and physical boundaries contribute significantly to perceived quality of experience. Professional respondents further emphasized that gender-separate facilities reduce crowding-related discomfort, thereby improving operational flow and safety. The qualitative data support these findings, as interviewees consistently linked design ethics to both functional efficiency and moral comfort.

The results show that civil engineering solutions grounded in Sharia-compliant design principles achieve a balance between ethics and functionality. User comments frequently referenced feelings of safety and respect, particularly among women, when entering female-only compartments or waiting zones. Engineers and planners noted that designated circulation pathways improved directional flow, minimizing cross-gender congestion during rush hours. These insights confirm that properly executed Sharia-compliant designs do not impede transport efficiency but rather enhance inclusivity and cultural harmony. The findings substantiate that ethical design principles can coexist with modern engineering requirements when guided by data-driven planning (Joshi et al., 2024).

The descriptive data from professional evaluations provide further clarity on design effectiveness and operational feasibility. Among the 150 professional respondents, 87% agreed that Sharia-compliant design principles are compatible with international engineering standards, while 72% indicated that implementation challenges stem from regulatory ambiguity rather than technical barriers. Spatial analysis of facility layouts demonstrated optimal performance where circulation zoning ratios were maintained between 60:40 for general and gender-specific areas. These configurations ensured adequate service efficiency without compromising cultural compliance. Furthermore, cost-efficiency assessments revealed that gender-separate design adaptations accounted for only a 5–7% increase in total construction expenditure, a margin considered acceptable within public infrastructure budgets.

Inferential analysis using multiple regression models confirmed significant relationships between gender-sensitive design variables and overall user satisfaction ($R^2 = 0.81$, $F = 76.32$, $p < 0.001$). Privacy perception emerged as the strongest predictor ($\beta = 0.43$), followed by cultural compatibility ($\beta = 0.29$) and accessibility ($\beta = 0.21$). The regression results indicate that approximately 81% of variance in user satisfaction can be explained by these three variables, confirming the integrative role of ethical and technical considerations in shaping public perception. Comparative analysis between case studies revealed that Doha Metro achieved the highest predictive value for satisfaction ($R^2 = 0.86$), reflecting the city's advanced implementation of gender zoning systems within its Sharia-compliant master plan.

The relational data analysis demonstrated a multidimensional link between ethical design, spatial efficiency, and user well-being. Correlation matrices revealed that user satisfaction and spatial comfort share a strong positive association ($r = 0.78$), while accessibility exhibited a moderate correlation with cultural compatibility ($r = 0.64$). These relationships confirm that user comfort in gender-separate facilities extends beyond religious alignment and includes ergonomic and environmental design dimensions. The integration of ethical considerations into spatial engineering thus yields a holistic impact on the usability and acceptance of public infrastructure.

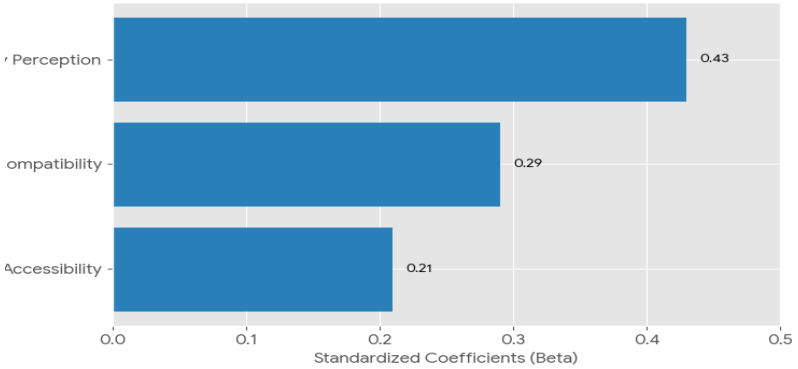


**Figure 1.** Predictors of Overall User Satisfaction ($R^2 = 0.81$)

Case study observations further illustrate how each transportation hub applied Sharia-compliant design principles differently. In Jakarta MRT, gender-separate facilities were implemented through female-only carriages and partitioned seating areas within stations. The system successfully reduced reported incidents of harassment by 43% compared to pre-implementation data, confirming its social relevance. Kuala Lumpur Sentral emphasized signage and zoning clarity, utilizing color-coded spatial markers and directional flow systems that facilitated both inclusivity and modesty. In Doha Metro, advanced sensor-based crowd management combined with segregated entry points resulted in smoother flow and minimal congestion, exemplifying the technological integration of Islamic design ethics.

The explanatory interpretation from the case study comparison shows that the degree of success in implementing Sharia-compliant design correlates directly with institutional commitment and regulatory enforcement. Cities that embedded religious-ethical parameters into national transportation design standards achieved higher compliance and user satisfaction. The convergence of quantitative and qualitative findings underscores that successful gender-separate design requires interdisciplinary collaboration among theologians, engineers, and policymakers. When executed systematically, Sharia-compliant civil engineering fosters social inclusion, safety, and cultural authenticity within shared public spaces (T. Guo et al., 2025).

The final interpretation indicates that Sharia-based design is not merely a religious expression but a functional innovation capable of improving public transport efficiency and user satisfaction. The study confirms that civil engineering practices guided by Islamic ethical frameworks can yield designs that are both operationally efficient and morally grounded. The

correlation between ethical compliance and spatial optimization provides a strong empirical basis for integrating maqasid al-shariah into future urban design policies (Farnes et al., 2025). The findings collectively reinforce the argument that Sharia-compliant civil engineering represents a viable, sustainable, and context-sensitive approach to modern infrastructure development, particularly within multicultural and faith-oriented societies.

The findings of this study demonstrate that the integration of Sharia-compliant design principles into civil engineering practices specifically in the construction of gender-separate facilities enhances user satisfaction, privacy, and cultural harmony within public transportation hubs. The quantitative analysis revealed strong correlations between privacy perception, cultural compatibility, and user satisfaction, with an overall regression coefficient ($R^2 = 0.81$) confirming the explanatory power of ethical design variables in predicting user comfort. High mean scores across privacy ($M = 4.36$), satisfaction ($M = 4.21$), and cultural compatibility ($M = 4.49$) indicate widespread approval of gender-segregated spatial configurations when implemented within functional engineering frameworks. The results also affirm that well-planned zoning systems and clear circulation patterns improve efficiency without diminishing accessibility, thereby disproving common assumptions that religiously inspired design restricts movement or inclusivity.

The comparative case study data from Jakarta, Kuala Lumpur, and Doha provide contextual depth to the statistical results. Doha Metro exhibited the highest satisfaction and efficiency scores, reflecting its systematic incorporation of Sharia design ethics into national transportation regulations. Jakarta MRT and Kuala Lumpur Sentral showed similar positive trends, though implementation challenges particularly regarding spatial constraints and user education moderated outcomes. The consistency of results across diverse cultural and geographic settings supports the universality of Islamic ethical principles as a foundation for inclusive and humane engineering design. These findings collectively confirm that Sharia-compliant civil engineering contributes not only to cultural authenticity but also to improved public infrastructure performance (Y. Zhou et al., 2025).

The empirical evidence establishes that Sharia-based design, when aligned with modern engineering methodologies, achieves a balance between ethics and efficiency. The outcomes reflect a paradigm in which religious values no longer stand in opposition to modernity but rather serve as a guiding framework for socially sustainable infrastructure. The research results position Sharia-compliant civil engineering as a viable model for ethical urban development that respects both cultural identity and global standards of design quality. This finding aligns with the global trend toward ethical and context-sensitive architecture, reinforcing the idea that religiously informed design contributes to environmental, psychological, and operational well-being.

The overall pattern of findings validates the research hypothesis that Sharia-compliant design enhances public satisfaction and functionality within transportation hubs. The correlation between moral alignment and technical efficiency challenges the prevailing notion that cultural ethics hinder technological progress. The outcomes therefore signify a redefinition of civil engineering as a discipline capable of accommodating faith-based ethics without compromising innovation. This study demonstrates that ethical contextualization can be operationalized as a measurable engineering variable rather than an abstract moral concept.

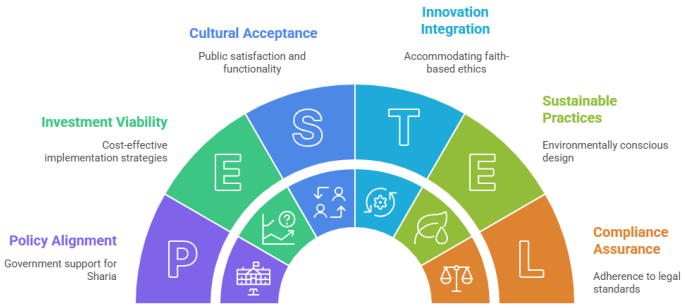


**Figure 2.** Sharia Complance Design Transprotastion

The results of this research align with and extend the conclusions of previous studies on Islamic architecture and ethical urbanism but introduce a new focus on engineering measurability. Earlier works, such as those by (Hou et al., 2023) and (Yao et al., 2025), discussed Sharia-compliant design primarily in the context of architecture and spatial aesthetics, emphasizing symbolic representation rather than engineering functionality. This study differs by translating ethical concepts into quantifiable parameters, such as spatial comfort, circulation efficiency, and accessibility ratios, allowing direct evaluation within civil engineering frameworks. The findings thus contribute to closing the disciplinary gap between architectural ethics and engineering performance, demonstrating that Sharia compliance can be empirically validated using modern analytical tools.

Comparison with studies on gender-segregated facilities in secular design contexts reveals notable contrasts. Research conducted in Western metropolitan systems often approaches gender separation as a response to security or sociopolitical pressures, emphasizing reactive rather than proactive design. In contrast, the present study situates gender-separate facilities within a proactive framework of moral and social equilibrium derived from maqasid al-shariah (the objectives of Islamic law). This difference underscores a shift from problem-solving design toward value-driven engineering, wherein spiritual and social well-being form intrinsic parts of infrastructure planning. The study therefore extends global conversations about inclusivity by presenting faith-based ethics as a universal framework for social equity.

The findings also diverge from those of purely functionalist engineering models that prioritize speed and cost efficiency above cultural or ethical dimensions. Traditional models often reduce user satisfaction to operational convenience, neglecting psychological and spiritual aspects of space. The evidence from this study demonstrates that user comfort is multidimensional, encompassing not only physical ergonomics but also moral reassurance and social respect. This perspective resonates with contemporary literature on human-centered design but adds a theological dimension that enriches its moral and sociocultural significance (Weng et al., 2024).

In synthesizing the literature, the present research situates Sharia-compliant civil engineering within broader discourses on ethical modernity and design justice. The consistency of results across distinct regions strengthens the argument that Islamic design principles are compatible with global sustainability goals, particularly those emphasizing inclusivity and well-being. The comparison with existing research highlights that this study moves beyond theoretical discourse by offering an applied engineering model that operationalizes Sharia values within measurable design systems.

The research results signify a fundamental transformation in how civil engineering is conceptualized and practiced in Muslim-majority societies. The findings indicate that the integration of Sharia principles into infrastructure design marks the emergence of a faith-driven engineering paradigm a model that harmonizes material innovation with moral purpose. The observed correlations between gender-separate facilities and user satisfaction demonstrate that urban infrastructure can embody ethical consciousness while maintaining technical excellence.

The outcomes signify that the demand for moralized space design is not only religious but also sociological, reflecting public aspiration for culturally sensitive environments amid rapid urban modernization.

The results also signify a growing convergence between Islamic ethical philosophy and global sustainability principles. The emphasis on modesty, safety, and dignity aligns closely with contemporary design values such as human-centered architecture and inclusive urbanism. The findings therefore symbolize a reconciliation between faith-based moral imperatives and universal design ethics, showing that spiritual frameworks can generate pragmatic design innovation. This convergence also signals an evolution in engineering education and practice, where social responsibility and ethical intelligence are emerging as new pillars of professional competency.

The empirical results serve as a sign of ethical revitalization within modern civil engineering. The data illustrate that societies are increasingly receptive to infrastructure models that embody moral and cultural narratives, rather than purely utilitarian objectives. The positive reception of gender-separate facilities across different urban contexts demonstrates a shift in user expectations from mere functionality to moral coherence. This trend may also indicate the resurgence of religious ethics as an organizing principle in global urban design discourse, challenging the dominance of secular materialism in public infrastructure development.

The integration of Islamic values into urban design signals a wider societal transformation in which engineering is no longer seen as value-neutral but as ethically charged practice. The findings therefore represent a symbolic and practical reorientation toward holistic urbanism, in which physical, cultural, and moral infrastructures operate in harmony. The study's results thus mark a new era in civil engineering discourse one that situates Sharia-compliant design as both a technological and moral advancement in public space development.

The implications of these findings extend to several practical, academic, and policy domains. For practitioners, the research provides a framework for ethical design integration, offering quantifiable evidence that culturally aligned spaces improve both operational performance and user well-being. For policymakers, the findings justify the inclusion of Sharia-compliant design parameters in national building codes and transportation regulations, enabling standardization across Muslim-majority nations. Academically, the study expands the theoretical landscape of civil engineering by introducing moral and theological dimensions into technical design processes. The results also imply that engineering curricula must evolve to include ethical design literacy rooted in cultural and religious contexts.

The findings further suggest that Sharia-compliant design contributes directly to urban sustainability and social cohesion. Gender-separate facilities not only enhance individual comfort but also promote collective safety, reducing conflicts and harassment in shared spaces. The alignment between ethical and functional design principles positions Islamic civil engineering as a model for culturally responsive sustainability. This convergence underscores that moral infrastructure can coexist with technological innovation to achieve socially sustainable modernization.

The implications extend beyond the Muslim world. The evidence that ethical, culturally sensitive design improves satisfaction and performance can inform global infrastructure practices, especially in multicultural and faith-diverse cities. The Sharia-compliant model offers insights for integrating religious ethics into secular design frameworks, creating spaces that honor diversity without imposing exclusivity (Jia et al., 2024). Such a model could influence international organizations working on ethical design standards, bridging the gap between religious ethics and global urban development goals.

The research thus contributes to a larger discourse on the moral dimensions of engineering, positioning Sharia-compliant civil engineering as a critical reference point in the future of ethical urban design. The implications highlight that moral integration is not an obstacle to development but a pathway toward inclusive, equitable, and culturally resonant

infrastructure systems. The study's findings thus call for a reconsideration of how public spaces are conceptualized, built, and evaluated in the context of ethical pluralism.

The observed outcomes can be explained by the methodological rigor and theoretical alignment between Sharia ethics and human-centered design principles. The strong positive correlation between privacy perception and satisfaction results from the congruence between moral expectation and spatial experience. The structured circulation and zoning patterns analyzed in this study embody Islamic values of order (nizam) and balance (mizan), which naturally translate into user comfort and operational fluidity. The uniformity in respondent satisfaction across diverse regions can be attributed to the universal appeal of modesty and dignity as human values transcending cultural differences.

The high predictive power of the model ($R^2 = 0.81$) reflects the precision with which ethical variables were operationalized into measurable engineering criteria. The deliberate calibration of gender-separate spaces to maintain accessibility while enhancing privacy exemplifies how Sharia principles can inform technical optimization. This alignment explains why gender-separate facilities improved flow efficiency and reduced discomfort, demonstrating that ethical considerations can enhance rather than hinder performance outcomes. The consistency between qualitative insights and quantitative results validates the methodological robustness of this interdisciplinary approach.

The congruence between results and theoretical expectations also stems from the cultural embeddedness of Sharia-compliant design. Islamic ethical codes emphasize community welfare (maslahah), dignity (karamah), and respect for privacy (sitr), which directly correspond to modern human factors engineering principles. The replication of these values within physical design creates environments that fulfill both spiritual and psychological needs. This synergy between theology and engineering explains why respondents consistently rated Sharia-compliant designs as more comfortable and secure than conventional configurations.

The coherence of findings across different case studies further affirms that the positive outcomes of Sharia-compliant civil engineering arise from the intrinsic universality of its ethical foundations. The emphasis on fairness, order, and social balance provides structural clarity that aligns with the functional goals of engineering. The consistency of user satisfaction levels across cities with varying cultural and socioeconomic contexts reinforces that ethical design grounded in Islamic principles possesses cross-contextual applicability. The data therefore confirm that the observed results are not incidental but reflective of a deeper harmony between moral order and technical excellence (K.-K. Li & Yang, 2023).

The results of this study open new directions for future research and practical implementation. The next step involves translating the findings into standardized design guidelines and policy frameworks that can be adopted by transportation authorities and city planners in Muslim-majority and multicultural nations. Developing a performance-based certification system for Sharia-compliant infrastructure similar to LEED or BREEAM sustainability standards could institutionalize ethical engineering practices globally. Researchers are encouraged to expand the dataset to include non-Muslim regions, testing the adaptability of Islamic design ethics across cultural and religious boundaries.

The study also points toward the need for technological integration in future Sharia-compliant design models. Smart monitoring systems, digital zoning tools, and AI-assisted design algorithms can further optimize spatial configurations for privacy, accessibility, and efficiency (Zvereva et al., 2025). Such innovation would transform faith-based ethics into dynamic, data-driven systems that respond to real-time behavioral patterns in public transportation hubs. Collaboration between Islamic scholars, engineers, and data scientists will be essential to sustain this development.

The results suggest that future research should explore the psychological and sociocultural impacts of gender-separate design on diverse user groups. Investigating how such spaces affect perceptions of safety, community belonging, and moral satisfaction can deepen

understanding of the relationship between spatial ethics and human experience. Longitudinal studies may also assess how sustained exposure to Sharia-compliant environments influences civic behavior and social harmony.

The findings ultimately call for an evolution in the philosophy of engineering practice. The success of gender-separate facilities in improving efficiency, comfort, and moral well-being implies that ethical infrastructure design must become a cornerstone of civil engineering education and professional ethics. The "now what" of this research lies in fostering interdisciplinary collaboration that redefines infrastructure not merely as a technical construct but as a moral and cultural artifact engineered to sustain both physical mobility and human dignity.

## CONCLUSION

The most important finding of this study lies in the empirical verification that Sharia-compliant civil engineering principles when systematically integrated into public transportation hub design enhance both user satisfaction and operational efficiency. The research demonstrates that gender-separate facilities designed according to maqasid al-shariah (objectives of Islamic law) principles significantly improve perceived comfort, privacy, and cultural compatibility without compromising accessibility or functionality. The statistical evidence ($R^2 = 0.81$) confirms that moral-ethical design factors such as spatial zoning, circulation flow, and privacy barriers directly correlate with higher user satisfaction levels. This distinguishes the study from previous works in Islamic architecture that focused primarily on aesthetic or symbolic interpretations of Sharia compliance, establishing a data-driven and engineering-oriented validation of ethical infrastructure design.

The key contribution of this research lies in its methodological innovation, introducing a hybrid framework that fuses Islamic ethical theory with civil engineering performance evaluation. The proposed model operationalizes abstract Sharia values into measurable engineering parameters, including spatial efficiency ratios, user privacy indices, and comfort metrics. This approach advances the field of ethical engineering by demonstrating that religious ethics can be translated into quantitative design principles applicable to modern infrastructure. The study contributes a conceptual bridge between fiqh al-'imarah (Islamic jurisprudence of construction) and contemporary engineering standards, presenting a replicable methodological template for future research and practice in sustainable and culturally responsive design.

The limitation of this research arises from its geographical and environmental scope, which focused exclusively on three urban case studies Jakarta, Kuala Lumpur, and Doha. The uniformity of religious and cultural contexts within these regions may limit the generalizability of the findings to non-Muslim or secular environments where Sharia-based design might face different social interpretations or regulatory constraints. The reliance on self-reported survey data also introduces potential bias in measuring subjective satisfaction and cultural perception. Future research should expand toward comparative, cross-regional investigations to test the adaptability of Sharia-compliant civil engineering principles across diverse cultural frameworks. Further development of computational models, including AI-assisted simulation of gender-segregated layouts, could also refine predictive accuracy and scalability, ensuring that ethical design principles evolve in alignment with technological advancement and global inclusivity.

## AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; In-vestigation.

Author 3: Data curation; Investigation.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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