

RECONSIDERING QIBLA ORIENTATION IN ACEH'S CULTURAL HERITAGE MOSQUES: AN INTEGRATIVE MULTI-MODEL TOLERANCE FRAMEWORK

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Abstract: Aceh is home to numerous historic mosques, many of which remain active places of worship and have been designated as cultural heritage sites. Their qibla (*qiblah*) orientations, however, may differ from modern astronomical calculations, while attempts at correction often encounter concerns regarding historical *ijtihad*, religious legitimacy, and heritage preservation. This study evaluates the qibla orientation of 13 cultural heritage mosques in Aceh using Google Earth-based geospatial analysis interpreted through the perspectives of *fiqh*, science, and tradition. The results show that 53% of the mosques exhibit substantial deviations of more than 5°, while 47% fall within the high, or moderate, precision categories. Based on these findings, the study develops a Multi-Model Framework for Qibla Direction Tolerance integrating five models: the Astronomical 3-Point Model, Symbolic Kaaba Radius Model, Actual Haram Boundary Model, Sociological Tolerance, and *Fiqh* Tolerance. The framework distinguishes geometric precision from normative legitimacy and enables qibla orientation to be evaluated contextually without neglecting astronomical accuracy, *fiqh* considerations, historical value, and community acceptance.

Keywords: Qibla Orientation; Cultural Heritage Mosques; Qibla Direction Tolerance; Aceh.

Introduction

Aceh is one of the regions rich in cultural artifacts in terms of religion.¹ During the Islamization process, the expansion of Islam in Aceh was marked by the establishment of mosques throughout the region, from east to west. These mosques were not only places of worship and centers for the spread of Islam, but also places for the transfer of knowledge to the community.² The mosques built during this period serve as historical witnesses to the formation of Islamic civilization in Aceh. Today, these mosques are referred to as ancient mosques or cultural heritage sites. Ancient mosques in Indonesia are commonly found in major cities, particularly in areas that were once Islamic kingdoms. These ancient mosques in such regions are still used as places of worship despite their advanced age.³

Old or ancient mosques are cultural heritage sites with a long history of construction, and as a result, several of these mosques have been officially designated as cultural heritage sites. According to Law No. 5 of 1992, cultural heritage consists of cultural heritage objects and cultural heritage sites, both of which have significant historical, scientific, and cultural value and are at least 50 years old.⁴ In this context, ancient mosques are architectural objects as well as expressions of religious culture that reflect the cultural continuity of Muslim communities at that time.

These historical, scientific, and cultural dimensions form the basis for determining material cultural heritage as cultural heritage sites.⁵ Cultural heritage is a form of national cultural wealth that has significant meaning for the understanding and development of history, religious education, and culture.⁶ Therefore, cultural heri-tage

¹ Masmedia Pinem, "Masjid Pulo Kameng Akulturasi dan Toleransi Masyarakat Aceh," *Analisa: Journal of Social Science and Religion* 20, no. 1 (2013): 87-98.

² Isman Pratama Nasution, "Nama-Nama Masjid Kuno di Nusantara dan Aspek yang Melatarbelakangi: Tinjauan Toponimi dan Arkeologis," in *Seminar Nasional Toponomi*, 2017, 122-38.

³ Ibid.

⁴ Yustisia Kristiana, *Geografi Parimisata* (Penerbit NEM, 2023), 33.

⁵ Hilman Handoni et al., *Yang Silam Jadi Suluh Jadi Suar: Masjid Warisan Budaya di Jawa dan Madura* (Direktorat Pelestarian Cagar Budaya dan Permuseuman, 2018), 14.

⁶ Andi Muhammad Said (ed.), *Refleksi 100 Tahun Lembaga Purbakala Makassar 1913-2013: Pengelolaan Pelestarian Cagar Budaya* (Makassar: Yayasan Pendidikan Mohammad Natsir, 2013), 15.

must be protected and preserved to raise awareness of national identity and national interests. In this context, the preservation of cultural heritage mosques goes beyond the maintenance of their physical structures and includes the protection of essential religious elements that are an integral part of their function as places of worship, especially the determination of the direction of the qibla (*qiblah*). Determining the direction of the qibla is not only a technical matter, but also a religious and cultural issue, as it reflects the rules of sharia, historical *ijtihad*, and the continuation of inherited religious practices.

Preserving mosques as cultural heritage is not limited to maintaining their physical structures. It also includes protecting the religious elements that are essential to the function of mosques as places of worship, including the direction of the qibla. Determining the direction of the qibla is not merely a technical matter, but also a religious and cultural issue, as it reflects sharia rules, historical *ijtihad*, and the continuation of inherited religious practices. On the one hand, cultural heritage mosques are often treated as historical artifacts that must be preserved without significant changes. On the other hand, the direction of the qibla is an element of worship that, according to sharia, requires accuracy and correction when proven to be deviant. The tension between the preservation of tradition and the demands of sharia and astronomical precision has not received much attention in studies of cultural heritage mosques in Aceh.

This tension is not only conceptual, but also evident in social practice. A number of case studies show resistance from administrators and congregations of ancient mosques to efforts to correct the direction of the qibla. For example, there was resistance to changing the direction of the qibla based on the belief that the inherited direction of the qibla was the result of *ijtihad* (independent reasoning) by scholars who had scientific authority at the time, and there was a fear that this would cause confusion among the community.⁷ Then there was also resistance to the results of the remeasurement,

⁷ Hasna Tuddar Putri, "Pergulatan Mitos dan Sains dalam Penentuan Arah Kiblat (Studi Kasus Pelurusan Arah Kiblat Masjid Agung Demak)" (Undergraduate Thesis--IAIN Walisongo, Semarang, 2010); Reza Akbar and Asman Asman, "Social Conflict Due to the Controversy of Mosque's Qibla Direction in Sejiram Village, Sambas Regency," *Jurnal Ilmiah Al-Syir'ah* 18, no. 1 (2020): 1-12; Saipudin, "Persepsi Masyarakat terhadap Pengukuran Ulang Arah Kiblat: Studi Kasus Masjid Baiturrahman di Desa Duman Lombok Barat" (UIN Mataram, 2024).

with people insisting on maintaining the old direction of the qibla even though scientific data showed a significant deviation.⁸ This shows that the issue of qibla direction is not only technical, but also related to sharia legitimacy and the continuity of religious tradition.

Previous studies on cultural heritage mosques in Aceh have mostly focused only on the architectural and physical aspects of mosques. Such as Laina Hilma's research on thermal performance, room acoustics, and sunlight in the old Indrapuri mosque.⁹ Next is the research by Aji Sofiana Putri et al., Aceh's Old Mosques: Reconciling Old and New Architecture, which relates to the architecture of the Teungku Di Anjong Mosque in Banda Aceh, the Asal Penampaan Mosque in Gayo Lues, and the Gunong Kleng Mosque in West Aceh.¹⁰ Research conducted by Della Irfana entitled "Efforts to Preserve the Bueng Sidom Mosque Cultural Heritage Site in Blang Bintang Subdistrict, Aceh Besar Regency."¹¹ The results of this study explain the architectural concept of the Bueng Sidom mosque and efforts to preserve it. Masmedia Pinem's research entitled Pulo Kameng Mosque: Acculturation and Tolerance of the Acehnese People.¹² This study describes the history of the Pulo Kameng Mosque and its architectural features. Similarly, research on ancient mosques in other areas is more related to architectural and historical elements, such as the study on Historical, Philosophical, and Contextual Values in Al-Wustho Mangkune-garan Mosque, Surakarta by Widya Astuti Nurjayanti, which explains the values inherent in the Al-Wustho Mangkunegaran Mosque building from his-

⁸ Muhajir et al., "Traditional Wisdom and Modern Methods in Qibla Direction: A Multicultural Study of Sunan Geseng Great Mosque, Indonesia," *Kavanna International Journal of Multicultural Studies* 5, no. 2 (2024): 186-98.

⁹ Laina Hilma et al., "The Evaluation of Thermal, Room Acoustics and Daylight Performance of Old Indrapuri Mosque in Aceh Besar, Indonesia," *Malaysian Journal of Sustainable Environment*, 2020.

¹⁰ Aji Sofiana Putri and Muhammad Naufal Fadhil, "Aceh's Old Mosques: Reconciling Old and New Architecture," *Heritage of Nusantara: International Journal of Religious Literature and Heritage* 12, no. 2 (2023): 149-86.

¹¹ Della Irfana, "Upaya Pelestarian Cagar Budaya Masjid Bueng Sidom di Kecamatan Blang Bintang, Kabupaten Aceh Besar" (Universitas Islam Negeri Arraniry Banda Aceh, 2022).

¹² Pinem, "Masjid Pulo Kameng Akulturasi dan Toleransi Masyarakat Aceh."

torical, philosophical, and contextual perspectives.¹³ All research results show no correlation whatsoever with the determination of the direction of the qibla. These mosques should be studied not only from an architectural perspective, but also from a religious context. The rituals and religious practices carried out in these mosques can become the identity of the spiritual traditions of the community in all aspects.

Research on determining the direction of the qibla in ancient mosques generally has gaps in the research area. For example, Novi Arisafitri's research entitled *Convergence of Qibla Direction Accuracy of the Old Air Tiris Grand Mosque Kampa Riau* discusses the accuracy of the qibla direction in ancient mosques in Riau.¹⁴ Next is related to the conflict of qibla calibration in ancient mosques in West Sumatra in the study "One Mosque, Two Qiblahs: Understanding the Difference in Qiblah Direction of the Nagari Suayan Mosque in West Sumatra, Indonesia" by Firdaus et al.¹⁵ Then there was M. Awaludin's research on reinterpreting the validity of the direction of the qibla in ancient mosques in Lombok.¹⁶ Similarly, Muhajid et al.'s research, "Traditional Wisdom and Modern Methods in Qibla Direction: A Multicultural Study of Sunan Geseng Great Mosque, Indonesia," describes the traditional method of determining the direction of the qibla in ancient mosques in Central Java.¹⁷ Meanwhile, the direction of the qibla in the field of astronomy is dominated by studies on the accuracy of the direction of the qibla in ancient mosques. Among them is a study by Tri Pangestu Utami entitled "Comparison of the Direction of the Qibla in the Ancient

¹³ Widyastuti Nurjayanti, "Historical, Philosophical, and Contextual Values in Al-Wustho Mangkunegaran Mosque, Surakarta," *Journal of Islamic Architecture* 7, no. 2 (2022).

¹⁴ Novi Arisafitri, "Convergence of Qibla Direction Accuracy of the Old Air Tiris Grand Mosque Kampa Riau," *Al-Hilal: Journal of Islamic Astronomy* 4, no. 2 (2022): 203-24.

¹⁵ Firdaus et al., "One Mosque, Two Qiblahs: Understanding the Difference in Qiblah Direction of the Nagari Suayan Mosque in West Sumatera, Indonesia," *Journal of Indonesian Islam* 13, no. 1 (2019): 73-95.

¹⁶ Muhammad Awaludin, "Re-Interpretasi Keabsahan Arah Kiblat Masjid Kuno," *ELFALAKY: Jurnal Ilmu Falak* 5, no. 2 (2021): 138-54.

¹⁷ Muhajir et al., "Traditional Wisdom and Modern Methods in Qibla Direction: A Multicultural Study of Sunan Geseng Great Mosque, Indonesia."

Mosques of Songak and Bayan in Lombok.”¹⁸ Then, research on the accuracy of the qibla direction of several ancient mosques on the Thousand Mosques Island by Ani Wafiroh,¹⁹ the latest research conducted by Khairul Anam et al. in East Java on testing the accuracy of the qibla direction of the Laju Sumenep Mosque.²⁰ Similarly, research using Google Earth as a medium for qibla calibration has been conducted by various researchers, including research by Rusding Muhalling et al., “The Qibla Directional Accuracy Determination Analysis Using Spherical Trigonometric Method and Google Earth,” which explains the inaccuracy of the qibla direction of mosques in the city of Kendari.²¹ All of these studies discuss the accuracy of the qibla direction of ancient mosques in several regions. Although the objects of study and methods are the same, there are differences in terms of culture and customs between the above studies and this study. Existing studies on the qibla direction tend to stop at measuring accuracy, without placing the results in the context of *fiqh*, religious authority, and the sustainability of community worship practices.

Although previous studies have examined cultural heritage mosques from the perspectives of architecture, history, acculturation, and preservation, while other studies have examined the qibla direction through astronomical measurements, these two groups of studies have not yet been extensively integrated into a single analytical framework. Research on cultural heritage mosques in Aceh generally emphasizes architectural characteristics, historical value, acculturation, and preservation efforts, whereas research on the qibla direction in ancient or traditional mosques typically focuses on measuring angular deviations and assessing their accuracy. The results of astronomical verification often stop at determining whether the orientation is accurate or inaccurate, without being further

¹⁸ Tri Pangestu Utami and Muhammad Awaludin, “Komparasi Arah Kiblat: Masjid Kuno Songak dan Majlis Kuno Bayan di Lombok,” *Al-Afaq: Jurnal Ilmu Falak dan Astronomi* 3, no. 1 (2021): 77-88.

¹⁹ Ani Wafiroh, “Akurasi Arah Kiblat Beberapa Masjid Kuno di Pulau Seribu Masjid,” *Nurani: Jurnal Kajian Syari’ah dan Masyarakat* 18, no. 2 (2018): 161-76.

²⁰ Khairul Anaam et al., “Uji Akurasi Arah Kiblat Masjid Laju Sumenep,” *Al-Afaq: Jurnal Ilmu Falak dan Astronomi* 5, no. 2 (2023): 223-32.

²¹ Rusding Muhalling et al., “The Qibla Directional Accuracy Determination Analysis Using Spherical Trigonometric Method and Google Earth,” *NeuroQuantology*, 2022.

contextualized within the framework of Islamic jurisprudence (*fiqh*), religious practices, and the socio-historical traditions of the communities that shaped the existence of these mosques.

This study fills that gap by framing the issue of qibla orientation not merely as a technical matter of measurement, but as an interpretive issue involving astronomy, *fiqh*, and tradition. Deviations in qibla orientation at heritage mosques are understood as a phenomenon that must be interpreted by taking into account astronomical accuracy, religious function, and the historical and sociocultural context of the mosque. The empirical contribution of this study lies in the provision of systematic data on the qibla orientation of cultural heritage mosques in Aceh. Its analytical contribution lies in the use of the Integrative *Fiqh*, Science, Tradition Framework, which brings together the results of astronomical verification with *fiqh* considerations and historical-social context. This framework was subsequently developed into the Integrative Multi-Model Tolerance Framework as a conceptual contribution of the study.

Therefore, this study aims to measure and analyze deviations in the qibla direction at cultural heritage mosques in Aceh and to explain how these astronomical measurement results can be interpreted from a *fiqh* perspective and within the historical and social context of the community. The research focuses on the relationship between the magnitude of deviation, normative considerations regarding the qibla direction, and the continuity of religious practices in mosques designated as cultural heritage sites. The integration of these measurement results and interpretations subsequently forms the basis for the formulation of the Integrative Multi-Model Tolerance Framework as a conceptual contribution of this research.

This study employs a qualitative approach supported by numerical-descriptive analysis²² based on Digital Research Methods. Numerical analysis is used to process the azimuth values of the qibla direction and building orientation, calculate the magnitude of deviations, and summarize deviation patterns through descriptive statistics.²³ These numerical results serve as the basis for a qualitative interpretation of the qibla direction as a religious practice related to

²² Joseph A Maxwell, "Using Numbers in Qualitative Research," *Qualitative Inquiry* 16, no. 6 (2010): 475-82.

²³ Gill Marshall and Leon Jonker, "An Introduction to Descriptive Statistics: A Review and Practical Guide," *Radiography* 16, no. 4 (2010): e1-e7.

historical *ijtihad*, local traditions, and community knowledge. The primary data were obtained from 13 cultural heritage mosques in Aceh identified through two official sources: nine mosques listed on the Ministry of Education and Culture's cultural heritage data page, accessed on October 28, 2024, and four mosques listed in the Aceh Cultural Heritage Preservation Agency's registry. These four mosques were not listed on the Ministry of Education and Culture's website. These mosques include the Medina Mosque, Pulo Kameng Mosque, Tuha Bugeng Mosque, Gunung Klieng Mosque, Tgk. Pucok Krueng Mosque, Tgk. Daud Beureueh Mosque, Poteumeureuhom Mosque (Labui), Tengku Fakinah Mosque, Tue Kebayakan Mosque, Indrapuri Mosque, Sidom Mosque, Teungku Chik di Kila Mosque, and Tgk. Chik Di Pasi Mosque. All 13 mosques identified from these two sources were included as research subjects. The selection of cultural heritage mosques was based on the consideration that historic buildings may undergo renovation, restoration, or reconstruction, while the orientation of the original structure can be preserved as part of the continuity of the building and religious traditions.

This study employs digital research methods,²⁴ which utilize digital platforms as tools for analysis and enable the integration of geographic, numerical, and visual data.²⁵ Google Earth is a leading digital medium due to its ability to integrate satellite imagery, geospatial coordinates, and directional projections with high precision.²⁶ Google Earth was used as a tool for geospatial analysis because it provides satellite imagery, geographic coordinates, and direction-measuring features. Geographic data was obtained by identifying the location and coordinates of each mosque on Google Earth, while the image dates were recorded for each object. The images used were taken between June 2, 2023, until June 30, 2025.

The measurement was performed by drawing two geometric lines directly on Google Earth. The first line was drawn from the mosque's location toward the Kaaba (*Ka'bah*) to obtain the azimuth value of the qibla direction displayed by Google Earth. The second line was drawn along the side of the building selected as the

²⁴ Richard Rogers, *Digital Methods* (MIT press, 2013).

²⁵ Catherine Dawson, *AZ of Digital Research Methods* (Routledge, 2019).

²⁶ Hamdan Mashuri Man, "Uji Akurasi Raşd Aal-Qiblah, Istiwa'aini, dan Google Earth terhadap Arah Kiblat Masjid Pondok Pesantren Miftahul Huda Al Mansyur Al Sunan Kalijaga Wonogiri" (IAIN Ponorogo, 2025).

reference line to obtain the building's orientation azimuth. Both azimuth values were recorded, and the difference was calculated manually to determine the magnitude of the deviation. The same procedure was applied to all 13 mosques. The deviation values were then analyzed numerically and descriptively and grouped based on the accuracy levels established in the study.

Qualitative analysis was conducted using the integration-interconnection paradigm,²⁷ which facilitates a dialogue between scientific findings and the normative framework of Sharia. At this stage, the deviations identified were interpreted through the concepts of *fiqh* as a form of contextual *ijtihad* applicable to regions geographically distant from the Kaaba. This approach allows historical practices to be critically evaluated without legitimizing errors or disregarding inherited religious authority. The interpretation also takes into account the historical and social contexts underlying the continued orientation of the building toward the heritage mosque.

Precision Pattern of Qibla Direction in Aceh's Cultural Heritage Mosque

The direction of the qibla is determined through calculation and measurement.²⁸ In calculations, determining the direction of the qibla in astronomy is done using three theories, namely trigonometry, geodesy, and navigation.²⁹ In modern practice, determining the direction of the qibla generally uses trigonometry, specifically spherical trigonometry, which calculates the azimuth of the qibla by connecting the geographical coordinates of a location with the coordinates of the Kaaba.³⁰ Other approaches, such as geodesy theory,

²⁷ M. Amin Abdullah, *Agama, Ilmu dan Budaya: Paradigma Integrasi-Interkoneksi Keilmuan* (Jakarta: Akademi Ilmu Pengetahuan Indonesia, 2013).

²⁸ Rahman Helmi et al., "Akurasi Setting Out Arah Kiblat Metode Bidang Bola dan Ellipsoid dengan Metode Rasyd Al-Qiblah," *Interdisciplinary Explorations in Research Journal* 2, no. 1 (2024): 280-98.

²⁹ Moelki Fahmi Ardiansyah et al., "Korelasi Fikih dan Sains dalam Penentuan Arah Kiblat," *Maslahah (Jurnal Hukum Islam dan Perbankan Syariah)* 8, no. 1 (2017): 13-30.

³⁰ Moedji Raharto and Dede Jaenal Arifin, "Telaah Penentuan Arah Kiblat dengan Perhitungan Trigonometri Bola dan Bayang-Bayang Gnomon oleh Matahari," *Jurnal Fisika Himpunan Fisika Indonesia* 11, no. 1 (2011): 23-29.

consider spherical, ellipsoidal, and flat reference surfaces³¹ and navigation theory, which uses a flat representation of the Earth based on the Mercator map.³² However, this calculation framework is rarely used in determining the direction of the qibla today.

In this study, the measurement of the direction of the qibla is determined based on the results of calculating the direction (setting out) to the ground surface of a location or the floor of a building. The direction of the qibla is operationalized through azimuth measurements, which represent the horizontal angle projected from a specific location towards the Kaaba.³³ Measuring the direction of the qibla involves adjusting the azimuth value calculated with the physical orientation of the mosque building, allowing for a comparison between the calculated direction of the qibla and the existing orientation of each mosque.

Google Earth is used as the primary digital tool for calculation and measurement processes. As a geospatial platform, Google Earth provides satellite-based visualization of the Earth's surface and uses geospatial data to represent locations through latitude and longitude coordinates.³⁴ Geospatial data systems integrate Global Positioning System (GPS), remote sensing, and spatial reference technologies, enabling a high level of positional accuracy that is extremely useful for navigation and directional analysis.³⁵ In determining the direction of the qibla, geospatial data serves as the main reference for identifying the geographical coordinates of the mosque and the coordinates of the Kaaba. The qibla azimuth was obtained by drawing a straight line from each mosque's location to the Kaaba on Google Earth, while the building's azimuth was obtained by drawing a second line along the side of the selected mosque. The difference between these two azimuth values was then calculated manually to determine the magnitude of the qibla deviation.

Based on this approach, the qibla direction of thirteen cultural heritage mosques in Aceh was calculated and measured using Goog-

³¹ Moehammad Awaluddin et al., "Kajian Penentuan Arah Kiblat Secara Geodetis," *Teknik* 37, no. 2 (2016): 84-87.

³² Ahmad Izzuddin, "Metode Penentuan Arah Kiblat dan Akurasinya," 2013.

³³ Helmi et al., "Akurasi Setting Out Arah Kiblat Metode Bidang Bola dan Ellipsoid dengan Metode Rasyd Al-Qiblah."

³⁴ Qiang Zhao et al., "Progress and Trends in the Application of Google Earth and Google Earth Engine," *Remote. Sens.* 13 (2021): 3778.

³⁵ Amazon, "Apa Itu Data Geospasial," <https://aws.amazon.com/>, n.d.

le Earth. The following is a summary of the qibla direction data measured using Google Earth:

Table 1. Recapitulation of Qibla Data for Cultural Heritage Mosques in Aceh Based on Google Earth

No	Re- gency/ City	Mosque Name	Qibla Di- rection (°)	Build- ing Ori- entation (°)	Devi- ation
1	South Aceh	Pulo Kameng Mosque	293.26	312.09	18.83
2	Bireuen	Tuha Bugeng Mosque	292.19	276.83	15.36
3	West Aceh	Gunung Klieng Mosque	292.89	308.18	15.29
4	Pidie Jaya	Tgk Pucok Krueng Mosque	292.21	302.77	10.56
5	Pidie	Tgk. Daud Beu- reuh Mosque	292.23	299.14	6.91
6	Pidie	Poteumeu- reuhom Mosque	292.19	285.35	6.84
7	Aceh Be- sar	Tengku Fakinah Mosque	292.21	284.72	7.49
8	Central Aceh	Kebayakan Mosque	292.71	292.71	0.00
9	Aceh Be- sar	Indrapuri Mosque	292.23	292.23	0.00
10	Aceh Be- sar	Bung Sidom Mosque	292.17	293.28	1.11
11	Nagan Raya	Tgk Chik di Kila Mosque	292.76	292.34	0.42
12	Pidie Jaya	Madinah Mosque	292.21	292.21	0.00
13	Pidie	Tgk Chik Di Pasi Mosque	292.21	292.42	0.21

The measurement at Table 1 results show that the direction of the mosque buildings is not homogeneous; there are significant angle variations between one mosque and another. This variation indicates that the method used to determine the qibla direction during construction was likely not uniform. Some mosques have a direction that is very close to the astronomical calculation, while others show a greater angle deviation. The differences in the mag-

nitude of these deviations must be understood within the context of qibla tolerance, as the limits of acceptable deviation are based on various principles in *fiqh* and astronomy. Based on the magnitude of these deviations, the data were grouped into three analytical categories: high, moderate, and low accuracy. This division into three categories is an analytical construct of the study designed to map the variation in deviations before the findings are interpreted through various models of *fiqh* tolerance.

This classification is situated within the context of the literature on tolerance regarding the direction of the qiblah, which indicates a spectrum ranging from the requirement of precision toward '*ayn al-Ka'bah*' to the sufficiency of facing *jiblat al-Ka'bah*. A review of the literature reveals a diverse range of tolerances, ranging from approximately 2° - 3° ³⁶ in a precision approach to broader limits,³⁷ such as 20° - 35° ,³⁸ and 45° ,³⁹ depending on the *fiqh* basis and the parameters used. This spectrum indicates that the magnitude of qibla deviation does not have a single tolerance limit in the literature. In this study, 1° and 5° were used as initial classification intervals to analyze data patterns, while the theoretical basis stemmed from the spectrum of qibla direction tolerances found in the literature, which was used to map variations in deviation before the findings were interpreted through various *fiqh* tolerance models.

Based on this analytical framework, qibla direction deviations were grouped into three categories: high accuracy (deviation $\leq 1^{\circ}$), moderate accuracy (deviation $>1^{\circ}$ to $\leq 5^{\circ}$), and low accuracy (deviation $>5^{\circ}$). These categories are used to describe the empirical patterns of the data and are not intended as normative boundaries regarding the validity or invalidity of the qibla direction from a *fiqh* perspective.

³⁶ R Ismanto et al., "Integrating Geospatial Technology and Islamic Jurisprudence: An Analysis of Qibla Deviation in Mosques," *Ulul Albab: Jurnal Studi dan Penelitian Hukum Islam*, 2026.

³⁷ Ahmad Musonnif et al., "Religious Moderation in Addressing Qibla Direction Deviation: A Case Study of Al-Munawwar Grand Mosque in Tulungagung, Indonesia," *Al-Hilal: Journal of Islamic Astronomy* 8, no. 1 (2026): 13-26.

³⁸ Hisbullah Salam, Alamsyah, and Sartika, "Astronomical Measurement and Fiqh Review of Qibla Deviation: A Case Study of Mosque and a Cemetery Complex in Timbuseng, Takalar," *Al-Afaq: Jurnal Ilmu Falak dan Astronomi*, 2025.

³⁹ Ahsin Dinal Mustafa, "Qibla Directions Through Ulama's Fatwa : Comparative Study between Qibla Direction Fatwa of Indonesian Ulama Council and Dar Al-Ifta Al-Misriyyah," *Al-Hilal: Journal of Islamic Astronomy*, 2019.

Mosques classified in the high-precision category include the Old Kebayakan Mosque, Tuha Indrapuri Mosque, Tengku Di Kila Mosque, Madinah (Teungku Japakeh) Mosque, Teungku Chik Di Pasi (Guci Rumpung) Mosque.

Table 1. High-Precision Mosque Qibla Direction Category

No	Mosque Name	Deviation (°)	Deviation Direction
1	Kebayakan Mosque	0.00	Aligned with Qibla
2	Indrapuri Mosque	0.00	Aligned with Qibla
3	Teungku Chik di Kila Mosque	0.42	Aligned with Qibla
4	Madinah Mosque	0.00	Aligned with Qibla
5	Guci Tgk Chik Di Pasi Mosque	0.21	Aligned with Qibla
Average Deviation		0.13°	

Table 2 shows the high precision category for the qibla direction of five mosques with deviations between 0.00° and 0.42°, and an average deviation of 0.13°. Numerically, this value is very close to the qibla azimuth calculated using geospatial methods, with three of them even recorded as 0.00°. However, the figure 0.00° should be interpreted as the result of rounding to two decimal places in Google Earth, not as absolute perfection without deviation.

The average of 0.13° indicates that the direction of the mosque buildings is almost identical to the direction of the precise qibla. When compared to the Quba-based mathematical tolerance model ($\pm 0.35^\circ$),⁴⁰ most are still within or very close to that limit. Even for the soil tolerance limit model ($\pm 0.19^\circ$),⁴¹ Several mosques remained within the permissible range, while the deviation of 0.42° slightly exceeded the limit but was still very small in practical terms.

Mosque classified in the medium-precision category is Bueng Sidom Mosque.

⁴⁰ Ma'rufin Sudibyo, "Sang Nabipun Berputar: Arah Kiblat dan Tatacara Pengukurannya," *Solo: Tinta Media* 7 (2011).

⁴¹ Agung Laksana and Muh Rasywan Syarif, "Telaah Matematis Variasi Lebar Arah Kiblat di Wilayah Indonesia," *Elfalak: Jurnal Ilmu Falak* 6, no. 1 (2022): 18-37.

Table 2. Medium-Precision Mosque Qibla Direction Category

No	Mosque Name		Deviation (°)	Deviation Direction
1	Bung Mosque	Sidom	1.11	West-Northwest of Qibla
Average Deviation			1.11°	

Table 3 shows that only one mosque falls into the moderate precision category, namely the Bung Sidom mosque, which has a qibla direction deviation of 1.11°. Quantitatively, this value is slightly above the high precision threshold ($\leq 1^\circ$) and still well below the qibla direction tolerance limit. Geometrically, this building is very close to the azimuth of the qibla calculated using geospatial methods, with a deviation that is considered small in the context of permanent buildings. However, in a geodetic context, namely whether the azimuth line from Aceh actually still points to the Masjid al-Ḥarām complex, the 1.11° deviation at the Bung Sidom Mosque cannot be said to point to the Masjid al-Ḥarām with precision. With a distance of approximately 7,400 km between Aceh and Mecca, a deviation of 1.11° is equivalent to a lateral shift (to the left or right) of approximately 140 km from the intended destination point of the Kaaba. Meanwhile, the angle width of the Masjid al-Ḥarām complex when projected from Aceh is only about 0.003° (about 11 arc seconds). This means that, geometrically speaking, the direction no longer falls within the angle width of the Masjid al-Ḥarām building or within the boundaries of the holy land. However, the 1.11° deviation is more likely to reflect technical limitations in measurement or construction tolerances than an indication of the use of non-azimuth methods. In other words, the direction of this mosque can be categorized as almost precise and, in practical terms, does not show any significant deviation.

Cultural heritage mosques classified in the low-precision category include Pulo Kameng Mosque, Tuha Bugeng Mosque, Gunong Kleng Mosque, and Teungku Pucok Krueng Mosque, Teungku Daud Beureueh Mosque, Po Teumeureuhom (Labui) Mosque, and Teungku Fakinah Mosque.

Table 3. Low-Precision Mosque Qibla Direction Category

No	Mosque Name	Deviation (°)	Deviation Direction
1	Pulo Kameng Mosque	18.83	North of Qibla
2	Tuha Bugeng Mosque	15.36	South of Qibla
3	Gunung Kleng Mosque	15.29	North of Qibla
4	Tgk Pucok Krueng Mosque	10.56	North of Qibla
5	Tgk Daud Beureuh Mosque	6.91	North of Qibla
6	Poteumeureuhom Mosque	6.84	South of Qibla
7	Tengku Fakinah Mosque	7.49	South of Qibla
Average Deviation		11.61	

Table 4 shows seven mosques classified as low precision with deviations ranging from 6,840 to 18,830, and an average deviation of 11,610. This value indicates that the deviation of the building’s direction from the qibla azimuth is significant. This means that the direction of cultural heritage mosques does not point precisely towards the Kaaba.

When compared to the qibla direction angle tolerance often referred to in three tolerance models, the first being the Quba mosque tolerance model (radius 45 km),⁴² geometric tolerance of soil,⁴³ and sociological tolerance.⁴⁴ Therefore, the average deviation of 11.61° clearly exceeds the angle tolerance limit commonly accepted in contemporary qibla direction correction practices. In other words, deviations in the low precision category are no longer within the range of minor variations, but rather indicate substantive differences in orientation.

The wide deviation range ($\pm 7^\circ$ to $\pm 19^\circ$) also indicates that the determination of the qibla direction in mosque buildings is likely not based on precise astronomical azimuth calculations, but rather on other approaches, such as a general estimate of the west direction, following road networks or land contours, or traditional estimation-based methods.

Overall, of the 13 cultural heritage mosques studied in Aceh, ten mosques (77%) showed measurable deviations between the ori-

⁴² Sudibyo, “Sang Nabipun Berputar: Arah Kiblat dan Tatacara Pengukurannya.”
⁴³ Laksana and Syarif, “Telaah Matematis Variasi Lebar Arah Kiblat di Wilayah Indonesia.”
⁴⁴ Ismail et al., “Toleransi Pelencengan Arah Kiblat di Indonesia Perspektif Ilmu Falak dan Hukum Islam,” *Al-Mizan* 17, no. 1 (2021): 115-38.

entation of the mosque building and the calculated qibla direction, while three mosques (23%) showed no angular deviation (0.00°). However, when the deviations are classified by magnitude, seven mosques (53%) fall into the low-precision category ($>5^\circ$), while six (47%) remain within the high, or moderate, precision categories. These findings indicate variations in the degree of alignment with the qibla direction among the cultural heritage mosques studied. The presence of deviations in these historic mosques provides an empirical basis for examining how different levels of deviation can be interpreted through a spectrum of perspectives on qibla direction tolerance.

Multi-Model Tolerance Framework: Integrating *Fiqh*, Tradition, and Astronomical Verification

The findings of this study indicate that variations in the accuracy of the qibla direction are a common characteristic of cultural heritage mosques in Aceh. Of the 13 mosques studied, seven (53%) exhibited deviations greater than 5° and were therefore classified as low precision, while the remaining six (47%) fell within the high- or moderate-precision categories. This pattern suggests that the observed deviations may reflect differences in historically embedded methods of determining the qibla direction. Similar variations in accuracy may also be found in other historical mosques that have not been officially designated as cultural heritage sites.

From a technical perspective, differences in the accuracy of the qibla direction are likely caused by two factors: human error and instrument error. Human error can stem from a limited understanding of astronomical calculations, lack of experience, or the use of simplified methods. In Indonesia, determining the qibla direction simply by relying on the direction of the sunrise and sunset is a popular method.⁴⁵ Indonesians understand the direction of the qibla to be west, because the Kaaba is located west of Indonesia. Therefore, the direction of the qibla is often assumed to be west. Although practical, this method does not take into account regional geographical variations, resulting in discrepancies when compared to results obtained through astronomical calculations.

⁴⁵ Helmi et al., “Akurasi Setting Out Arah Kiblat Metode Bidang Bola dan Ellipsoid dengan Metode Rasyd Al-Qiblah.”

From a *fiqh* perspective, practices such as these are not considered technical deficiencies, but are recognized as valid forms of *ijtihad*. Classical sources acknowledge the use of natural indicators, such as mountains, settlements, rivers, wind direction, and celestial phenomena, as means of determining the direction of the qibla. These means are used without involving precise calculations, a practice that has historically been accepted by the fuqaha.⁴⁶ In the Shāfiʿī school of thought, determining the direction of the qibla is understood through three levels, namely *qiblat al-yaqīn*, *qiblat al-ẓann*, and *qiblat al-ijtihad*, which reflect varying degrees of certainty and tolerance for Muslims who are far from the Kaaba.⁴⁷ This is often the legal basis for accepting an estimated orientation derived from contextual knowledge and inherited practices in determining the direction of the qibla.

In Aceh, this legal framework is deeply embedded in the local religious culture. Most *teungku* (clerics) follow the Shāfiʿī school of thought and rely on classical *fiqh* texts in applying sharia law.⁴⁸ This longstanding adherence has fostered strong cultural and emotional ties to inherited religious practices,⁴⁹ including in determining the direction of the qibla using traditional methods. As a result, the historical direction of the qibla in cultural heritage mosques in Aceh reflects *ijtihad* based on scientific knowledge at that time. In Shāfiʿī *fiqh*, determining the direction of the qibla for those who are far from the Kaaba is still obligatory to face the qibla through *ijtihad*. Therefore, determining the direction of the qibla using celestial objects and natural signs is considered valid *ijtihad*,⁵⁰ so that variations in the accuracy of the direction of the qibla in *fiqh* are acceptable.

Geospatial analysis reveals variations in the accuracy of qibla orientation at cultural heritage mosques in Aceh. These variations can be understood within the historical context of methods used to

⁴⁶ Arwin Juli Rakhmadi, *Kakbah dan Problematika Arab Kiblat* (Yogyakarta. CV. Arti Bumi Intaran, 2018), 22-23.

⁴⁷ A. Jamil et al., *Dinamika Arab Kiblat Masjid Agung* (Kolaborasi Pustaka Warga, 2023), 9-10.

⁴⁸ Zulkarnain, "Dinamika Mazhab Shafi'i dengan Cara Aceh: Studi Tentang Praktik Mazhab di Kalangan Tokoh Agama," *Ijtihad: Jurnal Wacana Hukum Islam dan Kemanusiaan* 15, no. 2 (2015): 159-76.

⁴⁹ Fauzi, "The Interactions of Madzhabs in Aceh: The Tripolar Typology," *MI-QOT: Jurnal Ilmu-Ilmu Keislaman* 41, no. 1 (2017).

⁵⁰ Abu Ahmad Najieh, *Fikih Mazhab Syafi'i* (Nuansa Cendekia, 2019), 187.

determine the qibla direction at ancient mosques across various regions. Before the advent of digital instruments, determining the qibla direction relied on visual astronomical observations, practical calculations, and traditional instruments. These methods included the use of a gnomon and the sun's shadow through the phenomenon of *rashdul qibla*.⁵¹ In the Indonesian archipelago, Sayyid Uthman recorded the use of the setting point of the star Arcturus (*maghrib al-simāk al-rāmih*) as a reference for the west-northwest direction.⁵² The *rubu' mujayyab* and astrolabe were also used for calculations based on latitude and longitude coordinates, while Polaris could serve as a reference for true north.⁵³ On the other hand, the orientation of an old mosque may also be determined by estimating the direction, imitating the orientation of a previous mosque, using a compass without correcting for magnetic declination, as well as traditions and beliefs that have developed within the community.⁵⁴

This historical diversity provides a basis for hypothesizing that differences in the degree of deviation among Aceh's heritage mosques may be related to differences in the precision of the qibla-determination methods used at the time of their construction. Mosques with very small deviations may indicate the use of relatively precise methods for determining direction, whereas larger deviations, especially when the building's orientation shifts north or south of the qibla azimuth, may indicate the use of an estimation approach or a general orientation toward the west. This interpretation remains a historical hypothesis based on comparisons with previously studied cases of ancient mosques. Verification of the methods actually used in each of Aceh's cultural heritage mosques requires further investigation of historical sources, local traditions, archives, manuscripts, and architectural evidence related to the process of determining the qibla and constructing the mosques. Therefore, these

⁵¹ Saddam Hussain, Chunrou Zheng, and Fu Juan, "The Mosque's Primary Spaces and the Required Direction of the Mosque Building," *Journal of Islamic Architecture*, 2023.

⁵² P. Bruckmayr, "Facing Mecca from Java: Two Treatises on the Establishment of the Qibla, and Their Scholarly and Social Context," *Islamic Law and Society*, 2023.

⁵³ Muhajir, Imam Yahya, and Frangky Suleman, "Analysis of Qicblat Direction at Jami Al Iman Mosque Sunan Geseng Loano Purworejo," *Jurnal Ilmiah Al-Syir'ah*, 2022.

⁵⁴ Alamsyah *et al.*, "Accuracy of Burial Qibla Orientation in Gowa's Allata Tradition: An Islamic Astronomy Perspective," *Jurnal Ilmiah Al-Syir'ah*, 2026.

variations in deviation should be interpreted not only within the framework of the accuracy of qibla determination methods in the past but also within a conceptual framework that distinguishes between the qibla as the result of astronomical calculations and the qibla as a concept in Islamic jurisprudence (*fiqh*), particularly through the concept of *jihat al-Ka'bah*, which allows for orientation toward the Kaaba.

Fiqh further explains the conceptual difference between “direction” as an astronomical concept and “qibla” as a *fiqh* concept.⁵⁵ Therefore, the concept of the direction of the qibla will be examined in two theories, namely the direction of the qibla in the sense of astronomy and the direction of the qibla in *fiqh* studies. In *fiqh* books, the qibla is the Kaaba. The word qibla has several meanings, including the direction mentioned in al-Baqarah [2]: 142-145. Qibla also means facing, which comes from the words قِبْلَةٌ - يَقْبَلُ - قَبْلُ, and can also mean the center of vision. In Arabic, the word qibla has the same meaning as the words *jibah*, *shaṭrah*, and *simt*, which mean direction of facing.⁵⁶ Therefore, in *fiqh*, the meaning of qibla is mentioned as two, namely ‘*ayn al-Ka'bah* (facing directly towards the Kaaba building) and *jihat al-Ka'bah* (facing towards the Kaaba). This concept illustrates flexibility in the direction of the qibla, especially for areas far from Mecca. By understanding that “*jihat al-Ka'bah*” provides leeway in determining direction, scholars and communities in the past could accept certain inaccuracies as long as mosques were oriented in the general direction of the Kaaba. The application of the concept of *jihat al-Ka'bah* is a form of harmonious integration between religion and science.⁵⁷ In modern practice, where science and technology enable greater accuracy through the use of spherical trigonometry and digital instruments, these standards have changed.

In astronomy, the meaning of qibla is integrated from the concept of *fiqh*, which defines qibla as the direction to face during worship. However, when the direction of qibla is defined as the direction to face, then the direction of qibla is interpreted as facing two opposite directions. This paradigm uses plane geometry theory in

⁵⁵ Jamil et al., *Dinamika Arah Kiblat Masjid Agung*, 13-14.

⁵⁶ Achmad Jaelani et al., *Hisab Rukyat Menghadap Kiblat (Fiqh, Aplikasi Praktis, Fatwa, dan Software)* (Pustaka Rizki Putra, 2012), 8-9.

⁵⁷ Ahmad Izzuddin, “Typology Jihatul Kaaba on Qibla Direction of Mosques in Semarang,” *Ulul Albab: Jurnal Studi dan Penelitian Hukum Islam* 4, no. 1 (2020): 1-15.

formulating the direction. From an astronomical perspective, the direction of the qibla is defined as the shortest great circle distance between a specific location and Mecca, calculated using spherical trigonometry based on geographical coordinates.⁵⁸ With the help of spherical trigonometry formulas, the direction of the qibla can be calculated accurately by considering the relative positions of the two points on the Earth's surface.

Astronomical theory does indeed operate in absolute space without room for interpretation. However, astronomy recognizes a margin of error. Tolerance arises at the level of normative and social application. However, in the context of the direction of prayer, mathematical tolerance is necessary to maintain a balance between the concepts of *fiqh* and astronomy. Although this method produces mathematically accurate results, *fiqh* introduces structured tolerance through categories of permissible orientation, ranging from *'ayn al-Ka'bah* to *jihat al-Ḥarām*. In the concept of *fiqh*, the term *jibah* refers to the meaning of facing a certain direction, without having to be exactly on target. For example, if a person who is praying is tied with a string and pulled straight forward, the direction will point to the Kaaba building, even though it may not physically hit it. That is the essence of *jibah*. From this concept, there are eight recognized categories of qibla direction, namely *'ayn al-Ka'bah*, *'ayn Masjid al-Ḥarām*, *'ayn al-Makkah*, *'ayn al-Ḥarām*, *jihat al-Ka'bah*, *jihat Masjid al-Ḥarām*, *jihat al-Makkah*, and *jihat al-Ḥarām*.⁵⁹

At the same time, mathematical tolerance must be considered alongside sociological realities. Mathematically, the tolerance for deviation in the direction of a mosque's qibla is determined by the leeway in choosing the direction to face. This choice includes facing directly towards the Kaaba, towards the Masjid al-Haram, or towards the sacred land as defined by the direction of the Quba Mosque. There are several mathematical tolerance models offered for the evaluation framework. First, the three-point reference astronomical model (Kaaba–Masjid al-Ḥarām–city of Mecca) calculates the azimuth difference between the direction toward the center of the Kaaba and the direction toward the boundary of the Masjid

⁵⁸ Ismail, "Arah Kiblat dalam Perspektif Fikih dan Geometri," *Mahkamah: Jurnal Kajian Hukum Islam* 7, no. 1 (2022): 54-78.

⁵⁹ Laksana and Syarif, "Telaah Matematis Variasi Lebar Arah Kiblat di Wilayah Indonesia."

al-Ḥarām complex or the city of Mecca. Since the distance between Aceh and Mecca is approximately 7,400 km and the width of the complex is only a few hundred meters, the angle formed is very small, namely around $\pm 0.05^\circ$ – 0.06° (approximately $\pm 3'30''$ to $\pm 2'30''$).⁶⁰ Both models of geometric tolerance are based on the boundaries of the sacred precinct. This tolerance is obtained from the difference between the azimuth towards the Kaaba and the azimuth towards the northeast boundary of the sacred precinct, as calculated in a study of variations in the width of the qibla direction; for Aceh, the value is approximately $\pm 0.191^\circ$ ($\pm 11' 28''$).⁶¹ Third, the mathematical tolerance model based on the Quba Mosque uses a ratio of 45 km to the distance between Aceh and the Kaaba ($\pm 7,400$ km). Using the formula $\Delta K \approx 45/S$, the tolerance obtained is approximately $\pm 0.35^\circ$ or $\pm 0^\circ 20' 53''$.⁶² Fourth, the sociological tolerance model uses a limit of $\pm 6^\circ$, which does not originate from the geometric construction of the sphere, but rather from practical considerations regarding the human ability to maintain body alignment during prayer. Fifth, the *jibah sughrā* model in the Ḥanafī school of thought sets a tolerance of $\pm 45^\circ$ (total 90°). The tolerance for the direction of the qibla for people who are far from Mecca is $\pm 45^\circ$ from the right and left sides of the Kaaba (total 90°). This model is not based on spherical geometry, but rather on the *fiqh* construction of the definition of the face (90° from the 360° circle of the human head).⁶³

In the context of cultural heritage mosques, these five models are not necessarily positioned as tools to “judge” the correctness or incorrectness of the direction of old buildings, but rather as an analytical framework for understanding the level of geometric precision as well as its historical-methodological context. This mathematical tolerance can be used as a consideration of the sociological aspects of society. Cultural heritage mosques that are rich in local wisdom need to be preserved and maintained, so that the end result is not only providing accurate qibla direction, but also

⁶⁰ Siti Nurul Iffah Faridah, “Toleransi Arah Kiblat Menurut Mazhab Hanafi dalam Perspektif Fikih dan Astronomi” (UIN Walisongo Semarang, 2017).

⁶¹ Laksana and Syarif, “Telaah Matematis Variasi Lebar Arah Kiblat di Wilayah Indonesia.”

⁶² Sudibyo, “Sang Nabipun Berputar: Arah Kiblat dan Tatacara Pengukuran-nya.”

⁶³ Faridah, “Toleransi Arah Kiblat Menurut Mazhab Hanafi dalam Perspektif Fikih dan Astronomi.”

maintaining social harmony and existing traditional values. Many cultural heritage mosques are connected to guardians, scholars, and saints. The community identifies them as mosques with distinctive architectural features. Each old mosque is often named after a scholar who played a role in the local community.⁶⁴

The establishment of a mosque is proof of the existence of a religious figure in an area. The presence of mosques during the era of Islamization in the archipelago always had a figure behind its establishment, and there were many events in its historical journey.⁶⁵ Examples of ancient and historic mosques built by the companions of the Prophet in the Middle East, such as the Quba Mosque, the Mosque of ‘Amr b. ‘Āṣ, the Mosque of al-Ḥākim bi Amr Allāh, and the al-Azhar Mosque, do not all face *‘ayn al-Ka‘bah*. These mosques were determined using astronomical phenomena in determining the direction of the qibla, not theoretical astronomy, so that the mosque faces *jihat al-Ka‘bah*.⁶⁶ Historic mosques certainly have an important value in the long history of Islamic civilization, including in determining the direction of the qibla. The process of determining the direction of the qibla in historic mosques not only reflects religious dynamics but can also show the expertise of scientists or architects of their time.

The reassessment of the direction of the qibla in Aceh’s cultural heritage mosques shows the interaction between Sharia norms, local religious traditions, and scientific developments. Facing the qibla is a mandatory requirement in worship, because the valid requirement for prayer is to face the Kaaba. However, reassessment cannot be carried out merely as a technical correction; it requires cultural interaction to preserve historical values and religious identity. Therefore, changing the direction of the qibla in cultural heritage mosques should not be understood simply as a physical change in the direction of the building. It requires a framework of interpretation that integrates Sharia, tradition, and science to maintain religious validity and historical integrity. According to Sharia law, facing the qibla is obligatory. However, the method of determining the direction of the qibla has multiple interpretations. The provisions for facing the

⁶⁴ Handoni et al., *Yang Silam Jadi Suluh Jadi Suar: Masjid Warisan Budaya di Jawa dan Madura*, 15.

⁶⁵ Ibid.

⁶⁶ Rakhmadi, “Kakbah dan Problematika Arah Kiblat,” 24-26.

qibla have been regulated in the book of *fiqh*, including the rules for those who are mistaken in their *ijtihad* in facing the qibla. If someone can see and knows the direction, they may follow the *ijtihad* of others as a guide. However, if the person they follow is mistaken, for example, pointing in a direction opposite to the qibla, then their prayer must be repeated. If the deviation is minor, it is advisable to repeat the prayer, but if they are confident in the direction they followed, then there is no need to repeat the prayer. *Ijtihad* in such circumstances remains valid.⁶⁷

Tolerance in *fiqh* can be a source of differences of opinion, but at the same time it also plays a role in finding solutions to problems that arise in society in determining the direction of the qibla. Astronomically, the direction of the qibla must be determined with precision, but in reality, the tradition of determining the direction of the qibla using astronomical phenomena has been practiced for centuries, resulting in a less precise direction of the qibla. In the first two or three centuries of Islam, it was shown that the qibla could be determined with a relatively high degree of accuracy, within a range of several degrees,⁶⁸ Despite using limited tools, this reflects a form of mathematical tolerance that is still relevant today. This slight deviation can be referred to as mathematical tolerance in determining the direction of the qibla. For astronomers, this is not justified, but the general public considers it an aid in performing religious rituals. *Fiqh* remains the guide in the tradition of determining the direction of the qibla.⁶⁹

Based on these conditions, the framework proposed in this study is based on the understanding that the orientation of historic mosques cannot be determined by a single astronomical or *fiqh* criterion. Cultural heritage mosques are religious artifacts that preserve the architectural orientation of a specific historical period.⁷⁰ This orientation may reflect astronomical knowledge, calculation and measurement methods, the use of instruments, social acceptance, and *fiqh*

⁶⁷ Najieh, *Fikih Mazhab Syafi'i*, 190-91.

⁶⁸ W. Schumm, "How Accurately Could Early (622-900 C.E.) Muslims Determine the Direction of Prayers (Qibla)?," *Religions*, 2020.

⁶⁹ Putri, "Pergulatan Mitos dan Sains dalam Penentuan Arah Kiblat (Studi Kasus Pelurusan Arah Kiblat Masjid Agung Demak)."

⁷⁰ Dedi Irama and Emy Herawati, "Islamization and Social Transformation in Colonial Manna, Bencoolen (1824-1942)," *Islamica: Jurnal Studi Keislaman* 20, no. 1 (2025): 28-51.

considerations that were prevalent during the time of their construction. On this basis, Sharia, tradition, and science are positioned as three interacting domains, while the five tolerance models in the Multi-Model Tolerance Framework are used as complementary analytical models, rather than as competing standards for establishing a single universal tolerance limit. The relationship between these three domains and the five tolerance models is formulated within an integrative framework, as shown in Figure 1.

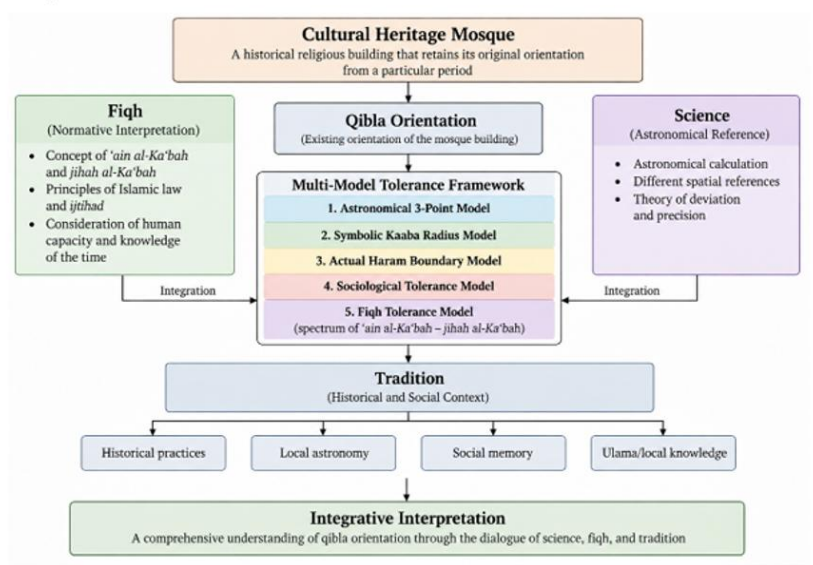


Figure 1. Integrative *Fiqh*-Science-Tradition Framework

Figure 1 illustrates the Integrative *Fiqh*–Science–Tradition Framework as an analytical model for determining the qibla orientation of heritage mosques through three interrelated domains: science, *fiqh*, and tradition. The science domain provides quantitative measures of the building’s proximity to the qibla direction through various astronomical and geometric references; the *fiqh* domain offers a normative framework for understanding the obligation to face the Kaaba within the spectrum of *‘ayn al-Ka’bah–jibah al-Ka’bah*; while tradition provides the historical and social context for the building’s inherited orientation. In the Multi-Model Tolerance Framework, the first three models, the Astronomical 3-Point Model, the Symbolic Kaaba Radius Model, and the Actual Haram Boundary Model, are used to analyze the orientation of a mosque based on differences in

astronomical and geometric references to the qibla. The Sociological Tolerance Model is used to analyze the scope of directional acceptance within the community's social practices, while the *Fiqh* Tolerance Model is used to situate deviations within the normative spectrum between *'ayn al-Ka'bah* and *jihat al-Ka'bah*.

The application of the framework to Aceh's cultural heritage mosques was carried out in three stages: measurement, cross-model comparison, and integrative interpretation. The first stage utilized geospatial measurement results to determine the deviation between the actual orientation of the mosque and the astronomically calculated azimuth of the qibla. The deviation value for each mosque serves as the starting point for cross-model analysis, which is then compared with the tolerance limits of each of the five models to determine whether the orientation falls within, on the boundary of, or outside the tolerance range of each model. The results of these comparisons produce a cross-model profile for each mosque, showing its orientation position within each model. The third stage interprets these profiles through three main domains, science, *fiqh*, and tradition, while taking into account the socio-historical context of the mosque as a cultural artifact.

Each model performs a different analytical function. The Astronomical 3-Point Model, Symbolic Radius Model, and Actual Haram Boundary Model examine the proximity of a building's orientation based on different astronomical and geometric references. The Sociological Tolerance Model assesses the degree to which society accepts qibla orientations that have become established practices, while the *Fiqh* Tolerance Model situates deviations within the normative spectrum between *'ayn al-Ka'bah* and *jihat al-Ka'bah*. In this framework, *jihat* is not positioned as a concept exclusive to a particular school of thought, but rather as a space within *fiqh* that allows for the interpretation of direction based on one's ability, knowledge, and the context of qibla determination. The differences in results among these models must be interpreted within the context of the traditions and history that have shaped mosque orientation.

Tradition is not positioned as a distinct model of tolerance, but rather as a contextual domain that encompasses historical practices, local astronomy, social memory, and ulama/local knowledge. Sociocultural practices do not arise in a vacuum, but are shaped by the

context and spirit of their time.⁷¹ The religious sphere has also evolved in tandem with social change, while local Islamic spiritual and cultural values have remained consistent.⁷² Therefore, the orientation of a mosque designated as a cultural heritage site must be understood within the socio-historical context that shaped it.

Within this framework, the five models were applied to 13 cultural heritage mosques in Aceh by comparing each mosque's deviation value against the tolerance limits of each model. Mosques with very small deviations will show strong alignment with more precise astronomical models and can be compared with other tolerance models. Conversely, mosques with larger deviations may fall outside the limits of a specific astronomical model but still remain within the broader scope of acceptance of social or *fiqh* models. These differences are not treated as contradictions that require one model to be chosen and the other rejected. Rather, they serve as analytical information to distinguish between the precision of astronomical measurements and the normative and social acceptance of a given orientation.

In the context of Aceh's cultural heritage mosques, this cross-model approach holds particular relevance because the orientation of the buildings is part of the historical record shaped by religious knowledge and practices during a specific period. If a mosque exhibits a high degree of conformity to the astronomical model, this finding indicates that its orientation is very close to the direction derived through modern astronomical calculations. If this same orientation also falls within the acceptable range of the *fiqh* and social models, then cross-domain convergence occurs, a state in which the dimensions of astronomical precision, normative acceptance, and the continuity of historical practices overlap to a significant extent. Conversely, if a mosque falls outside the most precise astronomical model but remains within the scope of the *fiqh* or social model, the result indicates cross-domain divergence. Such divergence does not automatically imply a historical error but rather highlights a discrepancy between modern standards of precision and the scope of acceptance available within normative and social contexts.

⁷¹ Ibid.

⁷² Abdul Wahid and Syukri, "Khataman Practice among Bimanese Muslims: Navigating Tradition, Modernity and the Formation of Religious and Social Identities," *Islamica: Jurnal Studi Keislaman* 19, no. 1 (2024): 112-40.

Based on this procedure, the Multi-Model Tolerance Framework is not intended to equate all tolerance models. Rather, this framework preserves the differences between each domain and uses those differences as the basis for analytical dialogue. Convergence among models can indicate a relatively strong alignment between the astronomical, social, and normative dimensions. Conversely, differences between models indicate a gap between modern astronomical precision and the scope of social or *fiqh* acceptance. Both of these conditions are maintained as analytical information in interpreting the characteristics of each heritage mosque.

This framework ultimately positions science as an instrument of quantitative clarification, *fiqh* as a space for normative interpretation, and tradition as a historical context. These three elements are not placed in a hierarchical relationship that negates any one domain, but rather in a dialogical relationship that allows for a more comprehensive understanding of the orientation of mosques designated as cultural heritage sites. This approach enables research to determine the precision of the qibla direction based on contemporary astronomical standards while also acknowledging that a mosque's orientation is the result of knowledge, *ijtihad*, social practices, and religious traditions that have evolved within a specific historical context.

Conclusion

This study shows that seven of the thirteen cultural heritage mosques in Aceh (53%) exhibit qibla deviations greater than 5°, while six (47%) remain within the high- or moderate-precision categories. These variations indicate differences in knowledge, methods, instruments, and practices for determining the qibla direction at the time of the mosques' construction. Historical-comparative evidence from other ancient mosques also reveals a diversity of methods for determining the qibla, allowing the orientation of heritage mosques to be understood within the context of the interplay between astronomical knowledge, *fiqh*, and tradition.

The main contribution of this research lies in the Integrative *Fiqh*–Science–Tradition Framework through the Multi-Model Tolerance Framework, which consists of the Astronomical 3-Point Model, the Symbolic Kaaba Radius Model, the Actual Haram Boundary Model, the Sociological Tolerance Model, and the *Fiqh*

Tolerance Model. These five models are not used to establish a single universal tolerance limit, but rather to interpret the orientation of mosques through astronomical, social, and *fiqh* dimensions. This framework allows astronomical measurement results to be interpreted more contextually by taking into account the scope of *fiqh* tolerance, social acceptance, and the historical context of the mosque's orientation.

The limitations of this study lie in the fact that no direct field verification or investigation of historical sources at each mosque has yet been conducted. Geospatial analysis has not yet been able to directly confirm the physical conditions or ascertain the methods, instruments, and practices used to determine the qibla direction at the time the mosques were built. Further research is needed to conduct field verification and trace the history of mosque construction, astronomical manuscripts, instruments, local astronomical knowledge, and sources or traditions of Islamic scholars related to the determination of the qibla direction. Further study is also needed to understand how mosque administrators and congregants respond to these measurement results, including choices to adjust prayer rows, add qibla direction markers, or maintain the existing orientation of the building.

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