Sacred Geometry: The Spiritual Meaning of Islamic Architectural Technologies

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Keywords: spirituality, design, practice, geometry, history, technology, symbolism

Introduction

"The study of sensible geometry leads to skill in all the practical arts, while the study of intelligible geometry leads to skill in the intellectual arts because this science is one of the gates through which we move to the knowledge of the essence of the soul, and that is the root of all knowledge." - Ikhwān as-Ṣafā

This paper studies the relationship between spirituality and architectural technology through exploring the use of sacred geometry within the context of the Islamic civilisation. The research sheds light on the ancient roots of geometry and its historical development as a technological and a hermeneutical tool in the Islamic tradition. It explores some of the ideas underpinning Islamic geometric design whilst discussing geometry’s contemplative, symbolic and potentially transformative nature. The paper also explores phenomenological aspects of traditional geometry practice in view of metaphysical and psychological understandings of imaginative and intuitive creative processes. Finally, the research considers the enduring relevance of this approach to contemporary Islamic architectural practice in view of the proliferation of modern computer-based technologies.

Ancient Origins

The relationship between mathematics and philosophy was very well established in antiquity as was the use of geometry as an architectural technology in construction. The use of geometry was evident in ancient Mesopotamian, Egyptian, Indian, Greek, Roman, Sassanian and Byzantine architecture. Although there is evidence that suggests the primacy of the Mesopotamian mathematical tradition, the remarkable similarity in mathematical problems, calculation techniques, and even diagrams particularly between the mathematics of ancient Mesopotamia, ancient Egypt and ancient Greece strongly suggest some sort of common scholarly tradition. Several Mesopotamian diagrams on tablets indicate compass marks and construction lines, suggesting a consistency in traditional geometry practice using compass and straight edge.

In ancient Egypt, geometric treatises explaining the design and construction of huge monuments date back to 1850 BCE. In ancient Greece, interest in geometry took place in

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2 Jöran Friberg, Unexpected Links between Egyptian and Babylonian Mathematics (Gothenburg, Sweden: Chalmers University of Technology, 2005)
3 Jöran Friberg, Amazing Traces of a Babylonian Origin in Greek Mathematics (Gothenburg, Sweden: Chalmers University of Technology, 2007)
5 The first group of treatises, written in hieratic script, comes from the late Middle Kingdom and Second Intermediate Period (1850–1550 BCE). The second, although a less well attested body of evidence consisting of mostly fragmentary material, written in demotic script, dates from the later Ptolemaic period.
three phases, the earliest characterised by philosophical and religious applications including representations of the cosmos, exemplified by the works of Thales (d.548/545 BCE), Anaximander (d.546 BCE) and Pythagoras (circa 550–495 BCE). These figures are thought to have traveled to Egypt and Babylon to gain specialised knowledge. The second phase, in hellenistic Alexandria, saw Euclid active in the 3rd century BCE. His treatise “The Elements” established the foundations of Euclidean geometry that dominated the field until the early 19th century. The third phase, in the late Hellenistic period, highlighted the works of Archimedes (d.c. 212 BCE) and Apollonius of Perga (d.c.190 BCE) who produced remarkable practical developments in mechanics and engineering. In Roman times, Vitruvius (d.c.15 BCE) wrote his enduring treatise “De Architectura” which illustrated a wide range of Roman building designs and technologies.

In ancient India, the Sulba sutras offered instructions for constructing various geometrical shapes used in the designs of fire-altars, temples and building bases which were constructed used the "peg and cord" technique. The Sulba sutras are considered the only early sources of Hindu mathematical knowledge originating in the Vedic period. The four most mathematically significant are those attributed to Baudhayana, Manava, Apastamba and Katyayana, the oldest of which dates back to c. 800 BCE - 500 BCE.

The Birth of Geometry in the Islamic Tradition

In the context of Islamic culture, the abstract nature of ornamentation is generally categorised into three types; calligraphy, arabesque (vegetal motifs) and geometry. The emergence of these art forms has been traced to various possible causes such as the prohibition of human and animal representations in Islam, the contemplative nature of the Arab people, and the forms of artefacts and tents of the desert nomads but these origins remain unproven. However, there is consensus amongst scholars that geometry emerged in Abbasid Baghdad between the 8th and 10th centuries, during the reigns of the caliphs Harun al-Rashid (r. 786–809), al-Mansur (r. 754–775) and al-Ma'mun (r. 813–833) who were known for their support of the Islamic sciences, with their rich palace libraries harbouring a vast opus of world wisdom. This was a period of scientific, economic and cultural flourishing, supported by various technological breakthroughs such as the mass production of paper which spread from China to the Islamic world in the 8th century and an assembly-line methodology for hand-copying manuscripts that led to the production of books. These technologies, together

and the Greco-Roman era of Egyptian history (300 BCE–300 CE). The most important of hieratic sources is the Rhind Mathematical Papyrus compiled by a scribe named Ahmose in the 33rd year of the reign of Awwer, a Hyksos ruler of Egypt, also known to historians as Apophis, who reigned circa 1585–1542 BCE). It is thought that this was copied from an older document dating from the time of Nymuatre (throne name, Ammenemes III), who reigned during the latter half of the 19th century BCE. See: Gay Robins, Charles Shute. The Rhind Mathematical Papyrus: An Ancient Egyptian Text (London: Trustees of the British Museum, 1987), 11.

5 Robert Hahn examines the possibility of a naturalist and architectural influence and inspiration on Anaximander’s cosmological imagination. He challenges the conventional idea of the transcendent origins of philosophy that precludes tacit knowledge by showing that Anaximander watched, and may have even worked with, architects building monumental stone structures at the time, and would have been influenced by architectural technologies such as the use of plans, elevations, column drum construction and modular design in the creation of his philosophical plans of the cosmos. See: Robert Hahn, Architectural Technologies And The Origins Of Greek Philosophy (Revista Archai, 2020), 1-28.


7 The abstract nature of ornamentation was categorised by Orientalists studying Islamic material culture in the Arab world in the 19th century.

8 For an analysis of Orientalist expositions on Islamic ornament and its effects on Western ornamentation see: Gülru Necipoğlu and Mohammad Al-Asad. The Topkapı Scroll: Geometry and Ornament in Islamic Architecture, (Santa Monica, CA: Getty Center for the History of Art and the Humanities, 1995), 60-70.

with a very well funded and varied patronage including the ruling family and their advisors, government officials, wealthy courtiers, scholars and scientists, fuelled a great translation movement that assimilated important works from ancient cultures, from languages such as Sanskrit, Persian, Syriac and ancient Greek, into the Arabic language in fields of knowledge as diverse as philosophy, astrology, alchemy, astronomy, physics, mathematics, occult sciences, music, botany, medicine, and other more marginal subjects. Many of the most important philosophical and scientific works of the ancient world were translated at this time, including the work of Galen, Hippocrates, Plato, Aristotle, Ptolemy and Archimedes. These works provided the foundation for much of the science that continues to inform our world today.

The works were not just translated literally, but adapted for the local culture, and the translators often wrote many books of their own developing the knowledge even further. The translations were often selected to serve certain theoretical positions already held and to provide information for debates already in progress in Abbasid society. The ideological and scientific orientation of these debates also influenced the way in which the texts were translated. These scholarly debates were fuelled by significant changes occurring in Islamic theology, where the classical Hanbalite approach that upheld the purity and literalism of the Quran and Hadith (sayings of the Prophet Muhammad) was pitted against the more rational Mu'tazilite approach which was unsuccessfully imposed on the religious orthodoxy by the caliph al-Ma'mun in 833. This controversy persisted until the Ash'arite approach offered a middle ground in 874 and the Maturidi approach then offered an alternative middle ground to that in 944. Both the Ash'arite and Maturidi approaches dominated Sunni Islam from the 10th century onwards. It is amidst such theological changes that the art of geometry was most likely born. Researcher Yasser Tabaa offers an example of this, suggesting that the art of muqarnas (stalactites) emerged as a reflection of an Ash'arite atomist understanding of the nature of matter that was prevalent in the Abbasid period, where atoms were thought to be held together by the will of God alone, highlighting the transient nature of the universe and the omnipotence and eternity of God.

The relationship between mathematics and philosophy played an important role in Islamic academia at that time, with mathematics providing central themes for philosophical reflection. The links between mathematics and philosophy during the Abbasid period have been categorised into four main groups; works by philosophers such as Maimonides (d.1204) who used mathematics as a source for philosophical activity, works by mathematician-philosophers such as al-Kindī (d.873) who solved philosophical problems mathematically, a very fruitful approach that generated new doctrines and disciplines, works by philosopher-mathematicians such as al-Tūsī (d.1274) who turned to mathematics to explain metaphysical concepts such as the emanation of creation from the Oneness of God, and some scholars go as far as saying that mathematics, more than any other discipline, has contributed to the genesis of theoretical philosophy. See: Roshdi Rashed, “The Philosophy of Mathematics” in Shahid Rahman & Hassan Tahiri, The Unity of Science in the Arabic Tradition. Science, Logic, Epistemology and their Interactions (2008), 133-34.
and works by mathematicians such as al-Khāwārizmī (d.850)\textsuperscript{17} and al-Karajī (d.1029)\textsuperscript{18} who attempted to resolve mathematical problems philosophically. The new emergent mathematics and rational philosophy influenced by neo-Platonism and neo-Pythagoreanism informed the work of many important Islamic scholars at the time including al-Rāzī (d.925), al-Fārābī (d.951), Ibn Bājja, and Ibn Sīnā (d.1037).\textsuperscript{19} The discipline of geometry expressed experimentation with these emergent mathematical and philosophical theories and the combination of architectural form and geometric pattern became seen as a practical, visual dialogue between art and science.\textsuperscript{20} The case of Ibn Sīnā, who used mathematics in philosophical synthesis, was important in that it marked a turn in ontology which permitted the mathematical treatment of philosophical problems.\textsuperscript{21}

From a political perspective, abstract geometric ornamentation may have served a unifying purpose during the Abbasid period, providing both an ideological and an aesthetic bond between the caliphs and the semi-independent Sunni rulers of a decentralised medieval Islamic world.\textsuperscript{22} This is contrasted to later dynasties such as the Ottomans of the 16th century, who adopted a more naturalistic, floral style as a way to assert their new identity, relegating the use of geometry mostly to wood and marble screens and \textit{muqarnas} designs.\textsuperscript{23}

Geometry played an important role in Sufi metaphysics, in describing the order of existence and the nature of creation as a manifestation of God.\textsuperscript{24} Its use as a hermeneutical tool is ranges from the early works of al-Hallāj (d.922) who explored geometry’s mystical symbolism,\textsuperscript{25} to the work of Ibn ‘Arabī (d.1240) who used geometry to symbolise multiple concepts from the Quran.\textsuperscript{26} It should be said that Sufi thinkers were critical of the philosophical approach (\textit{falsafa}) underpinned by mathematics, as it prioritised the rational faculty (\textit{’aql}) in the pursuit of knowledge. Sufis such as Ibn ‘Arabī and later, Aḥmad al-Fārūqī al-Sirhindī (d.1624) maintained that such a philosophy lacked the capacity for gnosis (\textit{ma’rifa}); the process of mystical revelation or intuitive unveiling that leads to the attainment of higher knowledge through the faculty of the inner heart (\textit{fu’ād}).\textsuperscript{27}

\textbf{Islamic Architectural Technologies}

The earliest accounts of the use of architectural drawings on paper in the Islamic civilisation also date back to 9th century Abbasid Iraq, before which they were generally sketched on

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\textsuperscript{17} al-Khāwārizmī integrated and developed ancient Indian, Babylonian and Greek knowledge to create, amongst other things, a new numerical system and the new discipline of algebra which is regarded as a cornerstone of the sciences. See, Solomon Gandz, \textit{The Sources of al-Khwarizmi’s Algebra} (Osiris, 1936), 263–277.

\textsuperscript{18} The Persian mathematician and engineer al-Karajī made significant contributions in freeing algebra from the ancient Greek approach to geometry. See, Roshdi Rashed, \textit{The Development of Arabic Mathematics: Between Arithmetic and Algebra} (London, 1994)


\textsuperscript{22} Roshdi Rashed, \textit{The Development of Arabic Mathematics},135.

\textsuperscript{23} Necipoğlu and Al-Asad, \textit{The Topkapi Scroll}, 125.


\textsuperscript{25} Akkach, \textit{Cosmology and Architecture in Premodern Islam}, 64.


plaster panels. Plans from drawings were often traced in situ, as demonstrated by an account attributed to the historian al-Tabari (d.839-923) describing how the plan drawing of the city of Baghdad was traced onto the ground with lines of ash, cotton seeds and naphtha which were then set alight so the caliph, positioned at the centre of it all, could visualise the design. As distinct from plans, elevations may have been geometrically-deduced on site during construction or built using full-scale templates and three-dimensional models.

Drawings ranged from initial architectural sketches through to finished working drawings and included general plans, schemes for muqarnas, calligraphy layouts and planar and spatial decorative geometric designs for brick masonry and tiles, amongst other elements. The drawings utilised various grid systems incised with a metal point or sometimes inked. For spatial applications, different levels were flattened in two-dimensions and highlighted using different colours. Radial grids made up of constellations of concentric circles were probably drawn using a compass. Geometric patterns were illustrated as repeat units to be mirrored symmetrically to build up a pattern.

Katya Nosyreva identifies two types of documents on geometry in Islamic architecture; manuals that describe the principles of geometric construction and, later, architectural scrolls intended as a references for an already-established visual vocabulary. These documents were sent from dynastic capitals to the provinces and also travelled further afield across geographic locals from one court to another. There is also contradicting evidence suggesting that scrolls were sometimes kept secret within family lineages of traditional master builders or masons.

Alpay Özduration shows how artisans used Abū al-Wafā Būzhjānī’s (d.998) book on applied geometry which illustrates the basic principles of geometry as a manual for architectural applications. Gülru Necipoğlu, in a study of the Topkapı Scroll, suggests that architects

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31 Keith Critchlow shows that the relationship between two and three-dimensional geometry is significant, where the two-dimensional plane is considered a convention symbolising subtle levels of emanation that indicate the direction and source of manifestation of the three-dimensional physical world. See, Critchlow, *Islamic Patterns*, 64.
35 Kitāb fī mā yaḥtāj ilayh al-sāniʿ min al-aʿmāl al-handasiyya (A Book on Those Geometric Constructions Which Are Necessary for a Craftsman).
37 The Topkapı Scroll is 29.5m long and 33 to 34cm high and contains 114 drawings. Its origins are unknown but it probably originated in Tabriz or Shiraz in Iran during the Safavid dynasty 15th/16th century, even though the muqarnas drawings on the scroll reflect the Timurid architectural style. It may have been looted by the Ottomans after the Ottoman–Safavid War.
were also referencing the 10th century mathematical treatise in “Rasā’il Ikhwān as-Ṣafā” (Epistles of the Brethren of Purity).\(^{39}\)

**Definitions**

The title ‘sacred geometry’\(^{40}\) is somewhat of a misnomer, since there is no literal distinction between ‘sacred’ and ‘profane’ in the Islamic tradition, as all things are considered to stem from the will of God.\(^{41}\) However, as a result of the progressive secularisation of the world, the suffix ‘sacred’ becomes essential when describing an approach to design underpinned by an intention to align with the physical proportions and symbolic meanings inherent in the natural, cosmic and, ultimately, the Divine orders.\(^{42}\) In such an approach, Islamic geometric designs take on a spiritual aura by means of their symbolism and contemplating them supports an experience of the inner spiritual dimensions of Islam, characterised by an ontological unity between form, spirituality and creative practice.\(^{43}\) However, there is a process that allows such ontological unity to emerge, which if neglected, can lead to a superficial aesthetic that is incapable of encompassing transcendent levels of meaning that connect human beings to God.\(^{44}\)

In the Quran, the word for ‘symbol’ is ‘‘āya’ (pl. āyāt)\(^{45}\) which denotes the proofs of God found through contemplation. The Quran states:

> 'We shall show them Our symbols (āyāt) on the horizons and within themselves until it will be manifest unto them that it is the Truth. But is it not sufficient concerning your Lord that He is, over all things, a Witness?'\(^{46}\)

This verse serves two purposes here; it implies a correspondence between macrocosm and microcosm, and suggests that contemplating God’s symbols not only proves He is the originator of all things in a rational sense, but has the capacity to lead to transcendent experience, since the act of witnessing suggests an ontological presence. Quranic cosmology describes existence in terms of hierarchical realms with corresponding ontologies leading from the Divine Essence (al-Ḏhāt) to the physical realm.\(^{47}\) For our purposes, this hierarchical order is articulated in terms of the physical (al-Mulk), the intermediary/angelic (al-Malākūt) and the spiritual realms (al-Jabārūt), Henry Corbin has associated these realms with specific organs of perception; the senses, the imagination (khayāl), and the heart (qalb), respectively.\(^{48}\)

Etymologically, the word ‘symbolism’ originates in the Greek verb symballein (to agglomerate/to unite), where symbols in different cosmological and ontological realms are joined together forming an integral unity.\(^{49}\) For each symbol in the physical world a series of archetypes exist like rungs in a ladder culminating in the Supreme Archetype in the Divine Essence.\(^{50}\) Symbols

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\(^{39}\) Necipoğlu and Al-Asad, *The Topkapı Scroll*, Ch.8.

\(^{40}\) Katya Nosyreva considers “sacred geometry” to be a global, twentieth-century phenomenon attributed to the teachings of the London-based Prince’s Foundation School of Traditional Arts. See: Nosyreva, “Lines of Transmission”


\(^{43}\) Akkach, Cosmology and Architecture in Premodern Islam, pp.xxii-xxiii.


\(^{45}\) The word ‘‘āya’ is literally means a single verse of the Quran composed of a string of words creating a sequence of unfolding meaning. For a fuller discussion on the meaning of the word in the Quran see, Akkach, *Cosmology and Architecture in Premodern Islam*, 27.

\(^{46}\) Quran 41:53


are therefore understood as an actual link between spiritual meaning, human experience and physical form. They engage the senses, the imagination and the heart. This suggests that the study and the use of geometry goes beyond considering it as a practical architectural technology to viewing it as an archetypal, symbolic design language that must encompass all these dimensions in order to be affective. It is perhaps in this light that Thomas Barrie aptly describes the geometric order of sacred architecture as a ‘communicative media’ and ‘an active agent’. In this way, the multivalent nature of geometry surpasses its use as a design tool; it becomes a vehicle for the realisation of metaphysical truths that supports spiritual experience, which underpins its enduring relevance to architectural practice.

This definition of geometry also reflects the traditional Islamic view of the creative practitioner as a vehicle of realisation enabling the manifestation of form by conforming to the Divine order, in other words, creating in light of spiritual inspiration. To explain this we turn to the etymological root of the word ‘architect’ in the Greek ‘arkhē’ (principle or primordial state) and ‘tekton’ (the one who built), thus, ‘the one who builds according to primordial principles.’ ‘Primordial’ is interpreted here as relating to the primordial cognitive function of the imaginal intuition, which can be understood in relation to anamnesis, a Platonic notion where one ‘re-members’ supra-sensory realities in the sensory world intuitively through the heart, not through the mind or senses. Imaginal intuition has been defined in psychology as a primal quality that utilises pre-conceptual symbolism in the meaning-making process, known as ‘the primary process,’ associated with early childhood and thought to be lost to a later more ‘mental’ intuitive process. For Freud, the primary process, which he calls ‘pre-personal auto-symbolic intuition,’ is not lost but rather repressed and continues to function in the deep unconscious when we sleep or dream. Higher states or transpersonal cognition are marked by a reawakened imaginal intuition, which, according to transpersonal theory, engenders the highest human qualities including creativity and intuitive wisdom.

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51 In Sufism, the experience of Tawḥīd is associated with the highest function of the spiritual heart, also referred to as the intellect (lubb) and the role of the intellect in perception is emphasised. See: Nicholas Heer, and Kenneth Honerkamp, Three Early Sufi Texts. (Louisville: Fons Vitae, 2003), 12-14.
55 Adrian Snodgrass and Richard Coyne, Interpretations in Architecture: Design as a way of Thinking (London: Routledge, 2006), 137.
57 Michael Washburn, “Transpersonal Cognition in Developmental Perspective.” Hart, Transpersonal Knowing, 185-212.
These definitions imply that design ideas and images may arise from beyond the binary of explicit and tacit knowledge, a significant prompt for contemporary designers seeking to create meaningful, transformative architecture. They may also shed light on how medieval designers may have created the mind-boggling geometric patterns we see in premodern architecture, which incidentally remains a mystery. We may find a clue in Orientalist explanations of abstract ornamentation created by Sufi artisans as ‘translations of mystical thought,’ suggesting the intricate patterns that adorned the walls of buildings were projections of spiritual meditations.

An example of such a mind-boggling pattern is displayed on a 15th century spandrel panel in the Darb-i-Imam funerary complex in Isfahan consisting of two superimposed star-and-polygon designs (Fig.1) which scientists Peter Lu and Paul Steinhardt observed were identical to tilings ‘discovered’ in the 1970s by mathematician-physicist Roger Penrose. Material scientist Dan Shechtman later identified these tilings as underlying the structure of the atoms of certain metal alloys, for which he was awarded the Nobel Prize in Chemistry in 2011.

A definition of the term ‘technology’ is also useful in the context of this paper particularly in relation to the ethics of making in the present time. The word is derived from the Ancient Greek concept ‘techne’ which Plato described as a form of knowledge and artistry. For Plato, techne was not merely a practical skill but a mode of understanding rooted in craftsmanship and creative insight. In his dialogue ‘Gorgias,’ he explores the ethical dimensions of techne, asserting that true knowledge (episteme) transcends mere technical expertise, a philosophical underpinning that introduces a nuanced understanding of the word ‘technology’ in our exploration of geometry as an Islamic architectural technology, highlighting the intertwining relationship of craftsmanship, knowledge, and spirituality.

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Epistemological Foundations
Ismail Al-Faruqi explains that the abstract forms of Islamic art function to help the believer intuit the absolute transcendence of a God who is beyond time and space.62 Islamic geometry as a media describes how the world unfolds from God in a knowable way, whilst the aesthetic experience of geometry reaches its full potential in an experience of Tawḥīd (Union or Oneness), the central premise of Islam.63 The doctrine of Tawḥīd posits that creation unfolds or emanates from the Oneness of God, and that Oneness enfolds the multiplicity of creation. Thus, the spiritual principle ‘multiplicity in Unity’ is seen as the basis for creation, both cosmologically and geometrically, as God’s Presence radiates through levels of existence to the physical level, just as a geometric design unfolds or emanates from a centre. On the other hand, the spiritual principle ‘Unity in multiplicity’ suggests that through the contemplation of symbolic physical forms, or the multiplicity of a geometric pattern, we can return to the source of Unity, the metaphysical and geometric centre. In Sufism, the microcosmic centre is the heart which seeks an experience of the Divine Presence. In practice, when drawing geometry a practitioner becomes centred as their state of consciousness is elevated.64

These ideas begin to reveal an underlying unity between geometry, spirituality and creative practice. To further unravel this connection, we turn to research by Laura U. Marks who draws on European concepts of ‘enfoldment,’ a term borrowed from quantum physics that draws a thread from the Neo-Platonist emanationism of Plotinus (d.270) to Gilles Deleuze’s (d.1995) concept of the fold, implying a broad continuity between Islamic and Western aesthetics, where the actual (zāhir) unfolds from the virtual (bātin). According to Mark’s reading of Deleuze, the virtual is, ‘An infinite plane of immanence... it contains all that has existed, will exist, has never existed, and will never exist, in a virtual state.’ Mark’s theory of enfolding and unfolding aesthetics incorporates three levels; image, information and the infinite65 reflecting the three cosmological realms from Quranic cosmology referred to above.

Sufi scholar Shāh Walī Allāh (d.1762) describes geometry as the descent of unity to multiplicity through symbolic (mithālī) connections where nearness to God is symbolised by the proximity of existent things to their centre.66 ‘Mithālī’ here relates to ‘ālam al mithāl’, the imaginal realm and the associated role of the imagination (khayāl) as discussed in Corbin’s doctrine Mundus Imaginalis.67 Corbin identifies a passive and active dimension to imagination; passive imagination represents and reproduces, and active imagination either falls into illusion or becomes cognitive and meditative by serving the innermost heart.68

Phenomenological Aspects
The opening quotation from Ikhwān as-Ṣafā posits geometry as a gateway to the knowledge of the soul. Ibn Khaldūn (d.1406) is attributed to saying, ‘It should be known that geometry enlightens the intellect and sets one’s mind right.... Our teachers used to say that the application of geometry does to the mind what soap does to a garment,’ indicating geometry’s purifying and spiritually transformative nature.69 For Critchlow, the highest function of

62 Ismail Al-Faruqi, Islamization of knowledge: General principles and work plan (International Institute of Islamic Thought, 1989), 261-69.
63 Nevine Nasser, “Beyond the Veil of Form: Developing a Transformative Approach Toward Islamic Sacred Architecture Through Designing a Contemporary Sufi Centre” (PhD diss., Prince’s School of Traditional Arts, University of Wales Trinity Saint David, 2019), 80.
65 Marks. Enfoldment and Infinity, 5.
geometry is linked to the heart and the imagination, helping the soul to rediscover itself. These ideas about the nature of geometry practice draws parallels with spiritual practice. The practical, philosophical and cosmological knowledge embodied by geometry was upheld by medieval Islamic craft guilds that were linked to Sufi Orders. Studies on the practices of medieval artisans show that both spiritual and creative qualities were cultivated through piety, contemplation and worship, with artisans receiving training in spiritual courtesy (adab), personal character and conduct, as well as in ritual practice. Artisans performed diverse rituals prior to undertaking certain tasks which in some cases still continues today. These rituals include, for example, visiting the tombs of revered saints associated with the craft tradition, reciting prayers, performing ablutions, chanting or singing during repetitive or arduous activities and using rhythmic recitations to regulate time. Such integration between creative and spiritual practices would have cultivated the capacity for artisans to receive inspiration from the spiritual realm, where their spiritual stations and personal spiritual experiences would have shaped their receptivity to revealed knowledge which was then expressed in form.

In an interview, contemporary Sufi artist and scholar Garry Doherty compared such ritual practices to contemporary art practice, where artists perform repetitive ritual acts albeit in a less formal and spiritual way, to cultivate a particular ontological creative state commonly referred to as 'the zone.' He compared contemporary ritual acts to traditional rituals and spiritual practices that activate anamnesis, which he described as 'pulling remembrance out of the void.' In both cases, he said creative practitioners experience a state of wholeness or oneness. Following such immersive creative experiences and states of oneness, he maintained that practitioners are better able to contextualise and rationalise their experiences in order to develop and complete their work. Doherty suggests that creative practice directly addresses a practitioner's existential void, which together with the creative zone, relate to the

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70 Azzam, Arts & Crafts of the Islamic Lands, 13.
72 Critchlow, Islamic Patterns, 8.
75 Azzam, Arts & Crafts of the Islamic Lands, 13.
81 E.M. Pesherova, Pottery Production of Central Asia, Moscow, (1959), 314-6, cited in Nosyrev, “The Unknown Craftsman and the Invisible Guild,” 44.
82 Milwright, Islamic Arts and Crafts, 40-1.
83 Nosyrev, “The Unknown Craftsman and the Invisible Guild,” 46.
85 A contemporary artist might address the intuitive creative zone directly through the subject or through the material of the work but very practical rituals or repetitive actions are typically performed to facilitate entering the intuitive or imaginal ‘arena,’ such as preparing and arranging brushes or tools, pigments or paints in a very specific way. Even seemingly insignificant actions such as smoking a cigarette or having a cup of tea when performed as part of an exact sequence of repeated actions may contribute to tapping into this creative zone. Recorded in a conversation with Garry Doherty, 24/01/2017, London.

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2024 Architecture, Culture, and Spirituality Symposium (ACSF 14) 10 of 19
imaginal realm. He suggests that the creative drive comes from a place of ‘not knowing,’ equivalent to this ‘existential void,’ and that spiritual practice supports a deepening understanding and experience of one’s true self. Therefore, in their contemporary function as platforms for self-enquiry, spiritual practice and creative practice are comparable. But at the same time, this comparison also implies how a tradition such as traditional geometry practice may gradually degenerate in the absence of formal spiritual training through a guild or Sufi Order.

Marsha Andreola, a contemporary geometer and educator practicing traditional, hand-drawn geometry, observes that practising geometry potentially connects and unifies human self, cosmos and the spiritual realm. She maintains that the symbolic nature of geometry and its ability to inspire contemplative states reveals a similarity between it and human consciousness in how they mediate the physical and spiritual realms. Similarly Nosyreva describes geometry as a bridge between the world of subtle creative principles and the physical order. In my own experience, I have found that drawing geometry by hand appeals to the imagination in a way that inspires ontological shifts, causes shifts in perception, affects the depth and rhythm of breathing and can occasionally evoke emotional or mystical experiences. Experiences that have eluded me when drawing geometry using CAD.

Andreola has also documented how practitioners of hand-drawn geometry naturally experience ‘apprehensions of higher knowledge, epiphanies, revelations and experiences of perfect happiness or bliss.’ Whereas Nosyreva describes how geometry can elevate consciousness to higher levels of reality leading to ‘elative’ experiences. These higher qualities commonly experienced by practitioners are then radiated and externalised through the artwork to be experienced by others, thus completing the circle of communication. Carlos Avendano articulates this experience as follows:

All those arrangements have in principle and in realisation the aim of satisfying the Will of Allah. The geometrical structure... is considered a divine gift because of its capabilities for revitalising inert matter... the effect... is a state of abstract contemplation which brings man to the profound condition needed to reach that internal well-being which puts him closer to God... aesthetic sensitivity is by no means denied in the search for spiritual growth: on the contrary it is a way of enhancing the whole human being.

In a similar way to poetry, geometry is capable of inspiring intuitive connections to the spiritual realm mediated by the imagination (khayāl). For Marks, geometry brings about new information or a new state affecting both practitioner and observer, even if there is no understanding of its symbolism. This can be explained by Andreola’s description of geometry as a ‘mesocosm’; an intermediary space or state of being that extends beyond object and subject and unifies the physical and spiritual realms, comparable to the notion of the barzakh (liminal space) in Islamic thought.

Practical Geometry
Traditional Islamic design practice is modelled on nature - the creation of the Divine Artist. Islamic philosophers compared God to an architect and architects modelled their buildings

78 Nasser, “Beyond the Veil of Form,” 84.
81 Nosyreva, “The Unknown Craftsman and the Invisible Guild,” 104-6
82 Ardalan and Bakhhtar, The Sense of Unity, 10.
85 Marks, Enfoldment and Infinity, 161-2.
according to the order of the cosmos. Ge6 Geometry utilised in the initial stages of the creative process reflects God's creative act through which He becomes manifest. In the Quran, the process of Divine creation is explained in terms of three stages; creating, fashioning and proportioning. This occurs through utilising proportions that underlie the structural interrelationship of creation, from the small to the large, outwardly reflecting God's inner beauty. Geometry which informs the language of proportion is utilised in design to create beautiful, contemplative forms. From an ontological perspective, visual beauty enables an experience of the higher consciousness of beauty which potentiates spiritual experience.

Geometry is considered the organising principle underlying pre-modern Islamic design. In practise, the art of proportion utilises geometric ratios known as proportional rectangles that are generated from a square and its diagonal in an ascending manner. Keith Critchlow considers the golden mean, √2 and √3 as the three key geometric ratios utilised in the design of Islamic sacred architecture. They are derived from the triangular, square and pentagonal surfaces of five regular forms that divide a sphere perfectly, known as the Platonic solids (Fig.2), attributed to Pythagoreanism, referenced in Plato’s *Timaeus* and then assimilated into the Islamic tradition by al-Kindī.

The Platonic solids are considered the foundation of the structure of matter. In Pythagoreanism, the perfect form of the sphere and circle symbolised the infinity and total mobility of Spirit. The platonic figures; the tetrahedron, octahedron, cube, icosahedron and dodecahedron represent visual symbols of the principle ‘multiplicity in Unity’ and relate to one another proportionally, one contained within the other in diminishing sequences known as duals. The tetrahedron symbolises the soul, the element fire and is its own dual. The octahedron symbolises movement, the element air and is the dual of the tetrahedron. The cube symbolises the

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References to these analogies are found in the biographies of Ottoman architects Sinan (d.1588) and Mehmed (d.1617) whose descriptions of the Sultan Ahmet Mosque, for example, is replete with allusions to nature and the cosmos. There are also semantic associations between artistic practice and the cosmos in the Arabic language. For example, ‘šamsa’ (little sun) denotes the central shape around which other elements of the design radiate. ‘Kawākib’ (planets) are concentric rows of shapes that appear like celestial bodies orbiting the central šamsa. See: Hamid Reza Farzanyar, “The Spirituality of Islamic Architecture: Symbolism and Meaning in the Traditional Buildings of Islam” (PhD diss., University of Birmingham, 2005), 183.

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Fig.2 The Platonic Solids
earthly domain and is unstable unless it encloses a tetrahedron. An interpretation of the 
relationship between the cube and the tetrahedron symbolises the hidden essence (bātin) of 
the earthly realm (zāhir) that makes it stable and whole, just as spirit (rūh) gives substance to 
earthly manifestations. The octahedron is the dual of the cube. The fourth platonic solid is 
the icosahedron, representing the element water and containing within it perfect golden mean 
rectangles, the proportion that underlies the structure of the natural world at all levels, and 
enfolds the fifth platonic body, the most important of the five, held in special regard and 
shrouded in secrecy by the Pythagoreans. The dodecahedron composed of twelve pentagonal surfaces symbolises the universe and life as a whole. This relationship between 
the icosahedron and the dodecahedron echoes a repeating theme in the Quran that reminds 
humanity that every living thing was created from water.

Geometry operates at different stages and scales of an architectural design and has visible 
and hidden dimensions. It is utilised to position and proportion architectural elements such as 
arches, vaults and domes and to create ornamentation as previously discussed. Hidden 
three-dimensional applications inform spatial ordering and structural solutions. Visible 
three-dimensional applications inform the design of sculptural elements such as muqarnas 
and crenellations. The relationship between two and three-dimensional geometry is significant 
and Critchlow, maintains that the two-dimensional plane is a convention that symbolises 
subtle levels of emanation indicating the direction and source of manifestation of the 
three-dimensional physical world.

Studies of Islamic sacred architecture indicate that compositional conventions and geometric 
systems were utilised to develop buildings over time. For example, the expansion of the 
Alhambra complex in Granada over a period of 500 years prior to the Catholic incursion, is 
governed predominantly by the golden ratio, $\sqrt{2}$ and $\sqrt{3}$ proportional systems, leading to an 
overall unified and harmonious spatial sensibility. The $\sqrt{2}$ proportion has been associated 

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94 Nevine Nasser, “Beyond the Veil of Form”, 92.
95 Critchlow, The Hidden Geometry of Flowers, 168.
96 Quran 21:30 states, “Have not those who disbelieve known that the heavens and the earth were of 
one piece, then We parted them, and we made every living thing of water? Will they not then believe?”
97 Critchlow, Islamic Patterns, 64.
98 Cabanelas, “La antigua policromía del techo de Comares de la Alhambra,” Al-Andalus (Vol. 35, 1970), 
76.
with the relationship between the imaginal and physical realms as well as the properties of sound. In a study by Valérie Gonzalez a complexity of geometric patterns and a metaphorical and variable aesthetic phenomenology are identified that are reliant on the imagination and involve an individual's active interpretation and experience. Drawing on Gaston Bachelard's influential book *The Poetics of Space*, Gonzalez calls this process a 'phenomenology of the soul'. These ideas may reflect the philosophical backdrop during the time the Alhambra was built, where the work of polymath and musician Ibn Bajjah (d.1138), and philosophers Ibn Tufayl (d.1185) and Ibn Rushd (d.1198) on aesthetics, particularly around the phenomenology of the soul, is thought to have influenced society and architecture at large.

Following research by Carlos Avendano, which I subsequently developed, Fig.3 demonstrates the use of the √2 proportion in setting out the plan of the side chambers of the Sala de Dos Hermanas and the Sala de los Abencerrajes, as well as the overall underlying geometric order governed by a cosmogram, a geometric pattern that features extensively in sacred architecture. Ardalan and Bakhtiar describe cosmograms as, ‘The reflection of the cosmos and the cosmic processes within all things.’ The use of cosmograms in design is understood to align human creativity to Divine creativity and physical form to the Divine order. A cosmogram is composed of four intersecting circles arranged along the axes of a central circle of equal radius. In the example shown, square abcd circumscribes the central circle defining the space. A √2 proportional rectangle defines the depth of the adjoining spaces created by the arcs af, de, ak, bi, bh and cg.

**Contemporary Design Applications**

Carol Bier suggests that in the context of Islamic sacred architecture, geometry represents 'programmatic cycles of meaning' related to specific verses of the Quran where the relationship between geometric patterns, ʿālam al-mithāl and the depiction of visionary space suggests literal associations between geometric patterns and metaphysical notions. I will now demonstrate an example of this approach by referencing an example from my own work - The School of Sufi Teaching, a meditation and community centre for the Naqshbandī-Mujaddidī Sufi Order in London, completed in 2020.

I will focus on the design of the main entrance (Fig.4) which explores an imaginal understanding of symbolism, geometry and light in meaning-making processes. Entrances or portals in Islamic sacred architecture reflect the significance of the threshold that delineates the sacred sphere.

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Nasser, *Beyond the Veil of Form,* 99-100.
Nasser, *Beyond the Veil of Form,* 100-1.
104 Ardalan and Bakhtiar, *Sense of Unity,* p.31.
105 This view relates to René Guénon’s understanding of the circle as symbolising the Divine Essence, both in terms of its centre and circumference, of the static square representing existence and the dynamic square representing manifestation. See, Guénon, René. *The Great Triad.* Hillsdale, NY: Sophia Perennis, 2001, pp. 22-3.
Drawing on the hierarchical levels of existence and utilising the proportioning conventions previously articulated, the entrance portal has three key sections emanating outwards:

1. Entrance door - symbolising the physical realm.
2. Geometric latticework fenestration framing the door - symbolising the imaginal realm. Created using a combination of hand-made and machine-made techniques.
3. The spandrel panel and stone epigraphic panel framed by border tiles - symbolising the spiritual realm. Created entirely by hand in the traditional method.

The various techniques used to create the overall portal provide an opportunity to explore the differences and similarities, pros and cons, of hand vs machine-made artefacts, of which a full discussion is outside the scope of this work but would certainly benefit from further research. The question that arises, is how the use of computers as a drafting tool and machines as a manufacturing tool affect the phenomenological and spiritual experience of designers and users and how they impact the circle of communication between them. I will return to this question briefly at the end of the paper in the section titled ‘Transformations in Practice’ but will now focus on the interrelationship between metaphysical concepts and geometric design in the context of creating the entrance portal of the Sufi centre.

Fig.4 Main Entrance, The School of Sufi Teaching, London, 2020

The human-scale entrance door, constituting the innermost level of the portal, symbolises the possibility of entering into the Divine Presence, where the symbolism of knocking on the door is seen to represent a seeker’s search for union with God and the door opening symbolises
the beginning of the path towards union with God. The next level of the portal, moving outwards from the entrance door, is composed of a frame of fenestration with embedded geometric latticework. The geometric pattern informing the latticework was developed by Katya Nosyreva in close consultation with the shaykh of the Sufi Order Hazrat Azad Rasool (d. 2006) with the aim to geometrically represent the Naqshbandī-Mujaddidī spiritual path, like a map, a project that preceded the construction of the building by over 15 years. The pattern visually depicts the dynamic process of spiritual progress through subtle centres of consciousness (laṭā'if) undertaken by a sufi aspirant on the spiritual path and corresponds to the Naqshbandī-Mujaddidī cosmology which was developed over centuries through a lineage of Sufi masters leading back to the time of the Prophet Muhammad (d. 632 CE). The pattern was utilised throughout the building to create an overall sense of unity both symbolically and ontologically and had come to be known as the signature pattern of the Order.

Fig. 5 Calligraphy panel in stone by Citi Youssoff and spandrel panel designed by Katya Nosyreva and handmade by Cova Hornero

The stone calligraphy panel (Fig.5) exhibits a verse from the Quran that describes believers entering into heaven in peace and security, conveying a view of Islamic sacred space as a gateway to the angelic realm (al-malākut). The geometric pattern in the spandrel panel (Fig.5) symbolises the complete Naqshbandī-Mujaddidī cosmology, depicted in terms of five

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109 Quran 15:45-6, translated, 'Lo! Those who ward off (evil) are among gardens and water springs. (And it is said unto them): Enter them in peace, secure'.
subtle centres of consciousness each positioned within twelve circles, symbolising twelve transmissions of the circles of the Naqshbandī-Mujaddidī spiritual path which each subtle centre of consciousness travels through, eventually merging with their original forms in higher, subtler realms before achieving union with God (fana’).

The border tiles (Fig.6) depict an eightfold pattern derived from an underlying cosmogram and constitute the final level in the hierarchical portal, framing all elements of the entrance, aligning physical, imaginal and Divine orders, reflecting the unity between macrocosm and microcosm, and the principles ‘multiplicity in Unity’ and ‘Unity in multiplicity’.

Transitions in Practice
In developing the original pattern with the shaykh, Nosyreva used the traditional hand-drawn method (Fig.7) in a ‘subtle process of progressive refinement.’ She describes working with Hazrat Azad Rasool, ‘Although there was not much verbal communication, observing Hazrat during those meetings was a most valuable experience, as if he were demonstrating something encompassing my artistic practice as well as my spiritual state.’ Nosyreva shares a beautiful quotation from Hazrat together with her personal reflection on it in relation to the geometric pattern they developed together, which I will reference here in its entirety as it aptly demonstrates the interrelationships between geometry, spirituality and creative practice that have been discussed throughout this paper:

‘Once, addressing a group of students on the importance of remembrance and recitations, Hazrat provided the following comparison:

“Have you ever looked out across a field in the early morning, when the dew is glistening in the sunlight? At a certain time of day, you can see millions of tiny spiderwebs, linking every one of the leaves and blades of grass. How can it be? How many spiders does it take to make all those webs? Each spider spins nothing more than a filament, yet taken altogether, those filaments transform the whole lawn into a single giant web. So too, each recitation links the heart to something greater than itself, and enhances its power. Human beings are of one heart and one Creator. The more one realises this truth, the more powerful one’s recitations become.”

110 Nosyreva, “The Unknown Craftsman and the Invisible Guild,” 146
The visual affinity of the geometric pattern… to an intricately woven spiderweb aspires to serve as a metaphor for the inextricable relationship of individual self to the whole of creation.  

Nosyreva’s account is now compared with the following excerpt from Craig S. Kaplan, a computer scientist referencing contemporary geometers using computer-aided technology:

“We have new mathematical tools: a modern conception of geometry that enables us to describe with precision what designers of the past could only hint at. We have new algorithmic tools: computers and the abstract mathematical processing they enable allow us to perform calculations that were intractable in previous generations. Finally, we have technological tools: manufacturing devices that can turn a synthetic description provided by a computer into a real-world artefact. Taken together, these three sets of tools provide new opportunities for the application of computers to the analysis and creation of ornament.”

Kaplan’s enthusiasm for new technologies aptly reflects the revolutionary advances we are now seeing in the field of architecture, from 3D printed construction to generative design algorithms to AI-powered 3D modelling and much much more. Perhaps this is an echo of the paradigm shift that occurred in the Abbasid period when Sufi scholars warned that the new mathematics and rational philosophy lacked the capacity for gnosis (ma’rifah); the process of mystical revelation or intuitive unveiling that underpins transcendent experiences through the faculty of the inner heart. Kaplan’s account speaks of technology as powerful and superior tool, where the notion of techne that encompasses ethics, craftsmanship and creative insight seem long forgotten. Whatever the case may be, the ideas presented in this paper may offer a reflection and a reminder about what it actually means to be human.

Fig. 7 Hand-drawn repeat unit. After: Nosyreva (left) and a computer rendering of the final arrangement used in the design of a book cover for the Sufi Order. After: Daniel von Sturmer (right).

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Epilogue
Since completing The School of Sufi Teaching, feedback from the community has been positive, confirming that designing according to symbolic narratives, in the way touched upon briefly here, can support the spiritual development of others. I will end with an excerpt from Jennifer Wayne, a member of the Naqshbandī-Mujaddidī community:

‘As I step each week over the threshold of the Zawiya [sufi centre] it’s like I have come home… It is a place where my heart feels at rest, the tranquility of the space along with the visual stimulation of the design join together as if joining me back to myself, the self before the world and it’s noise entered my heart… As… I step out… but hold in heart and mind the tranquility I have left behind and how a building that is built from the heart of love and truth can go towards transforming my own heart on its way to love and truth.’

113 From an interview with Jennifer Wayne, recorded 02/11/2022, London.