



AN APPROACH TO EXAMINE THE GEOMETRIC PROPORTIONS OF BUDDHIST STUPA ARCHITECTURE IN THE AMARAVATI REGION, ANDHRA PRADESH.

The Cultural Landscape of Buddhism in Amaravati.

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Abstract: This paper examines the geometric proportions of Buddhist stupa architecture in the Amaravati region of Andhra Pradesh, India. By incorporating the influence of megalithic burial mounds. Local traditional knowledge may have contributed to the design and proportion of Buddhist stupas. By examining the geometric proportions of these ancient structures, through archival drawing analysis, stone slab examination, and comparative analysis, this research investigates the evolution of stupa design from early to late periods, with a focus on changes in **shape, proportion, Fractal Geometry, and geometric patterns**. It explores the relationship between geometric proportions and the morphology of Buddhist stupas, examining the mathematical concepts, symmetry, balance, and distinctive features that characterize Amaravati stupa architecture.

Keywords: Amaravati Stupa, geometric proportions, megalithic burial, Local traditional knowledge.

I. INTRODUCTION

"தேவை பழக்கமாகும், பழக்கம் வழக்கமாகும், வழக்கம் பாரம்பரியமாகும், பாரம்பரியம் பண்பாடாகும்" (The Tamil proverb) "Need becomes practice, practice becomes custom, custom becomes tradition, tradition becomes culture" can be applied to the study of the geometric structures of Amaravati stupas. Each word of this proverb reflects a fundamental aspect of the stupa's construction. Through this study, we will explore how the geometric structures of Amaravati stupas evolved from a need into a traditional knowledge system. By analyzing the stupas' shapes, sizes, and mathematical calculations, we can gain new insights into the mathematical knowledge, artistic skills, and spiritual beliefs of the people of that time.

The Buddhist stupas in the Amaravati region of Andhra Pradesh, India, are renowned for their unique architectural features and rich cultural significance. This research explores these stupas' geometric proportions and symbolic essence, aiming to understand how their design evolved and the role of mathematics, geometry, and spirituality in their construction. The stupa, derived from the ancient word "stupa" meaning mound, originally served as a burial monument containing relics but later evolved into complex structures embodying Buddhist cosmology. The Amaravati stupas are particularly notable for their distinctive dome (anda), circular base, harmika (square railing), and chhatra (umbrella-like structure). These features symbolize the cosmos, the Buddha's teachings, and divine presence. By analyzing the geometric proportions of these stupas, this study will examine the influence of local traditions, particularly megalithic burial mounds, on stupa design. The hemispherical shape of stupas, believed to have evolved from earthen burial mounds, reflects a continuity of cultural practices that shaped early Buddhist architecture. This research investigates understanding the symbolic essence of the geometric forms utilized in Maha stupa in Amaravati. to elucidate how these geometric proportions of Amaravati Maha stupa are significant to this region, thus providing insight into the underlying knowledge systems present in the local traditional knowledge system. Qualitative Analysis Themes derived from Drawings and Archival records will be identified and analyzed to present a nuanced understanding of **Geometry and Proportion** of the stupas. This qualitative data will enrich the interpretation of **architectural Morphology** and its meanings. Quantitative Analysis The numerical data obtained from measurements with **proportion and ratio** will be analyzed statistically to reveal patterns and correlations among the evolution of stupa proportion and Geometry. This quantitative approach will lend support to the conclusions drawn from qualitative research.

Objectives: Analyze the geometrical proportions of Buddhist stupas in the Amaravati region (Amaravati style) 1. **Identify the underlying principles and mathematical concepts** that guided the design and construction of these stupas. 2. **Explore the relationship between geometrical proportion and Buddhist stupas' cultural and religious significance** in the region. 3. **Examine the influence of local traditional knowledge and practices** on the development of stupa architecture in Amaravati.

Sub-Objectives:

- 1. **Study the evolution of stupa design** from early to late periods, focusing on changes in shape, size, and ornamentation.
- 2. **Analyze the use of different geometric shapes** (e.g., circles, squares, rectangles) in stupa construction.
- 3. **Investigate the application of mathematical concepts** such as the Pythagorean theorem and the golden ratio.

analysing the proportions and geometry of the Amaravati Maha Stupa from the archival data

Diameter of the Stupa (base): 53.8 meters, Total Height of the Stupa (including harmika): 35 meters, Height of Harmika: 2.3 meters, Height-to-Diameter Ratio (Height of stupa ÷ Diameter of base). Harmika-to-Total Height Ratio (Height of harmika ÷ Total height). Dome Height (excluding harmika) for geometric clarity: $35 - 2.3 = 32.7$ meters $35 - 2.3 = 32.7$ meters, $35 - 2.3 = 32.7$ meters.

Feature	Measurement (meters)	Geometric Ratio
Diameter of Base	53.8	-
Total Height (with Harmika)	35.0	0.6506
Height of Dome (excluding Harmika)	32.7	0.6078
Height of Harmika	2.3	0.0657

Eight-to-Diameter Ratio: The total height of the stupa (with harmika) is approximately **65%** of its base diameter, reflecting proportional balance. **Dome Height-to-Diameter Ratio:** The dome's height (excluding the harmika) is around **61%** of the base diameter, maintaining a hemispherical form. **Harmika-to-Total Height Ratio:** The harmika constitutes about **6.57%** of the total height, emphasizing its smaller yet significant presence.

Proportions and Structural Comparison Megalithic Burial Mounds are typically small, hemispherical in shape, and constructed with locally available stones and clay. They were designed to cover burial urns or ashes, symbolizing a protective enclosure. The scale was modest, and the proportions depended on the burial's cultural and ritualistic importance. Stupas evolved from the same hemispherical structure, but their proportions became larger and more intricate over time. The Amaravati Stupa, as depicted, shows a perfectly proportioned dome (dome-to-base ratio ~0.6) with added elements like harmika and Chhatra. The base of the stupa represents stability, while the harmika and Chhatra symbolize spiritual ascent. Key Evolution in Proportions, Burial mounds: Small, simple hemispheres. Early stupas: Modest enlargements of burial mounds, retaining hemispherical proportions. Later stupas: Introduction of grand bases, Vedika's, and ornamentation while preserving the hemispherical dome. Cultural Practice and Adaptation Burial Mounds: Rooted in local beliefs about ancestor worship and the afterlife. The mound protected the deceased's remains and represented the sacredness of death and rebirth. Stupas: Buddhist stupas absorbed the idea of rebirth and protection but adapted it to symbolize the Buddha's relics and the journey toward enlightenment. Adaptation: When Buddhism spread, it amalgamated local burial traditions with its symbolic framework. The cultural acceptance was seamless because the core concept of sacred enclosures resonated deeply with existing practices. Chronological Evolution, Megalithic Phase: Starting with cairns, dolmens, and urn burials during the prehistoric period (2nd millennium BCE). Transition Phase: In the Mauryan period (3rd century BCE), Asoka's stupa-building campaign marked a shift. He repurposed burial mound architecture for Buddhist stupas, emphasizing relic enshrinement. Complex Stupas: By the Satavahana period, stupas like Amaravati became monumental, incorporating intricate carvings, Vedika, and Anda. Complexity of Adaptation Material Knowledge: Megalithic builders used stone slabs and earth. Stupa construction introduced bricks, stucco, and lime plaster. Techniques: Burial mounds required rudimentary piling. Stupas integrated advanced masonry, geometry, and ornamentation. Cultural

Type of farm	Distribution (n=Frequency)		Type of farm (N=Number of farms sampled)	Herd size (Mean±SE)
Small	n	10266	Small N=175	3.13±0.08
	%	78.80		
Medium	n	2660	Medium N=100	9.52±0.30
	%	20.40		
Large	n	97	Large N=75	36.38±3.65
	%	0.70		
Total		13023	Overall N=350	12.08±1.05

Negotiation: Local populations embraced stupas because they evolved organically from their burial mounds, with new religious meanings layered atop older practices. Local Knowledge and Techniques Burial Mounds: Relied on traditional craftsmanship using minimal tools and local stone. Stupas: Borrowed and elevated local techniques, introducing mathematical precision (e.g., proportional designs) and aesthetic sophistication (e.g., carvings, harmika).

The Anda (hemispherical dome) shape of stupas is not arbitrary but deeply rooted in symbolism and functionality: Cosmological Representation: The Anda symbolizes the universe, representing the infinite, the womb of creation, and the cycle of life and death, aligning perfectly with Buddhist cosmology. Structural Stability: A hemispherical dome is structurally efficient, distributing loads evenly, which makes it durable. This was crucial for enshrining relics and ensuring longevity. Continuity of Tradition: The stupa's shape evolved from earlier megalithic burial mounds, which were hemispherical in form. These burial mounds symbolized protection and rebirth, which the stupa reinterpreted as enlightenment and spiritual ascent. Rejection of Other Shapes: Cubes, cuboids, or pyramids might convey rigidity or linearity, inconsistent with the Buddhist philosophy of the cyclical nature of life. The

Aspect	Megalithic Burial Mounds	Buddhist Stupas	Comparison
Shape/Geometry	Simple hemispherical or mound-like shapes.	Hemispherical domes with structured bases, harmika, and chhatra.	Stupas expanded on the mound's hemisphere by adding vertical elements and platforms.
Base Diameter	~2–8 meters (small, localized structures).	Large: Amaravati Stupa ~53.8 meters.	Stupas scaled up the burial mound's size significantly.
Height	1–4 meters (depending on the burial's importance).	Amaravati Stupa ~35 meters (including harmika).	Stupas achieved greater verticality, symbolizing spiritual ascent.
Height-to-Diameter Ratio	~0.5 (close to hemispherical).	~0.65 (Amaravati).	The stupa's proportions retained the essence of burial mounds but extended the height.
Core Material	Local stones, earth, and clay.	Bricks, lime mortar, and stucco.	Stupas utilized advanced materials while retaining local craftsmanship.
Surface Treatment	Plain, unadorned mounds.	Ornamented with carvings, vedikas, and toranas.	Stupas incorporated complex iconography, reflecting the shift to a cultural and religious monument.
Symbolism	Protection of the deceased's remains, rebirth.	Protection of relics, enlightenment journey.	Stupas expanded the symbolic meaning while maintaining continuity with the theme of sacred enclosures.
Added Features	None.	Harmika, chhatra, vedika, toranas, gateways.	Stupas grew more elaborate, reflecting social, religious, and architectural evolution.
Cultural Adaptation	Local ancestor worship and burial practices.	Integrated Buddhist relic worship and regional traditions.	The stupa seamlessly adopted and transformed local practices into a Buddhist framework.
Construction Technique	Simple piling of stones and earth.	Advanced masonry, proportional geometry, and carvings.	Stupas introduced new techniques while building on local expertise.

reflect a balance between monumental scale and proportion. Ornamental Additions: Unlike earlier stupas, the Amaravati style added intricate carvings on the Vedika's (railings) and Torana's (gateways), showcasing scenes from the Buddha's life and local motifs. Regional Influence: Amaravati incorporated regional craftsmanship, using lime mortar and brick construction, which allowed for greater precision and decorative detailing. Harmika and Chhatra: The addition of the harmika and Chhatra extended the structure's verticality, reinforcing its symbolism of spiritual ascent while maintaining Anda's proportion. The proportions of stupas, including the Amaravati Stupa, were guided by religious, symbolic, and practical considerations: Mathematical Precision: Proportions like the height-to-diameter ratio (~0.65) of the Amaravati Stupa reflect a keen understanding of geometry, creating a visually harmonious structure. Symbolism: The proportions were intended to evoke balance between the earthly (base) and spiritual (dome and harmika). This aligns with Buddhist teachings about the middle path and harmony. Aesthetic and Ritualistic Needs: The size and proportions ensured the stupa served as a focal point for worship, drawing pilgrims with its grandeur while enabling ritualistic circumambulation (pradakshina) around the Anda and Vedika. Natural Inspiration: The stupa's form reflects natural shapes (e.g., the egg or womb), symbolizing life, protection, and continuity. The Amaravati Stupa's evolution reflects a timeline of cultural and architectural transformations: Megalithic Period (Pre-Buddhist Era): Local traditions of hemispherical burial mounds laid the foundation for stupa architecture. These mounds symbolized protection and rebirth. Mauryan Period (3rd Century BCE): Emperor Ashoka's stupa-building campaign standardized the hemispherical form, spreading the Anda structure across India while incorporating Buddhist relic worship. Satavahana Period (1st Century BCE–2nd Century CE): The Amaravati Stupa reached its zenith under Satavahana patronage. This period saw: Increased scale and ornamentation. Development of narrative carvings depicting Jataka tales. Introduction of regional elements and lime mortar techniques. Decline and Rediscovery: After the decline of Buddhism in India, the stupa fell into disuse until its rediscovery and reconstruction in the colonial period. Today, it stands as a testament to the amalgamation of local and Buddhist traditions.

Conclusion Statement: the Amaravati Stupa is a masterful example of how architectural traditions evolve through cultural amalgamation and local adaptation. Its Andra shape, symbolic proportions, and intricate details reflect the intersection of regional traditions and Buddhist ideology. The structure's evolution from megalithic burial mounds to a monumental Buddhist stupa illustrates a continuous dialogue between the acceptance and adaptation by local people, making it a cornerstone cultural heritage.

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