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The Vedic architecture of twin Indus valley civilization cities: Mohenjo-Daro and Harappa

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Abstract
The Indus Valley Civilization (IVC), with its principal urban centers Mohenjo-daro and Harappa, presents one of the earliest examples of large-scale urban planning in human history. While much scholarship has focused on its material culture and undeciphered script, less attention has been given to the underlying architectural principles that governed its design. This paper employs a multidisciplinary methodology combining stratigraphic analysis, ancient textual comparisons (notably the *Śilpa-śāstras* such as the *Manasāra*), and comparative studies with Near Eastern sites to demonstrate how Vedic sacred-geometry ideals were inherited and transformed into a practical, guild-regulated urbanism. Detailed examination of street grids, citadel complexes, public monuments (Great Bath, assembly halls), residential typologies, and granaries reveals a dynamic interplay between ritual form and material function. Later Buddhist and post-IVC layers illustrate continued sacred use of these precincts. The findings argue for a continuity of Vedic spatial grammar cardinal orientation, platform elevation, water rites that was innovatively adapted to meet the demands of burgeoning Bronze Age trade and civic administration.

Keywords: *Manasāra*, Indus Valley Civilization, Mohenjo-daro, Harappa, Vedic architecture, urban planning, citadel, Great Bath, granaries, stratigraphy

1. Introduction
India's ancient narrative emerges from the age old tradition of Shruti and Smriti while it is still supported to a large extent by the material evidence scattered across its vast subcontinent. While the Vedic corpus as suggested by our western authors who feel that Veda's couldn't have been written before 1500-500 BCE may be correct but the origin and mandalas are much much older than even Indus Valley Civilization. The architecture as seen in the Indus Valley is a sophisticated cosmology of fire, water, and cosmic order much in the same manner as prescribed in the *Shulba Sutras* and architectural treatises like the *Manasara* (Kaushish & Kaushish 1994; Chakrabarti 2012) [4, 3]. The Indus Valley Civilization (6500-1900 BCE) manifests these ideals in brick, mortar, and mortar-lined channels (Kenoyer 1998; Possehl 2002) [5, 9]. This convergence invites a critical question:
How did Vedic sacred-geometry principles influence, and ultimately transform, into the pragmatic urban forms of Mohenjo-daro and Harappa?
Previous scholarship has treated the IVC and Vedic worlds as discrete phenomena (Wheeler 1968; Senner 1989) [15, 13], yet both share core spatial grammar: Cardinal orientations, raised ritual platforms, and communal water rites. This paper advances the thesis that the IVC cities represent a transitional architectural idiom where Vedic cosmic alignments were reinterpreted through the exigencies of Bronze Age urbanism, guild-controlled economies, and expanding trade networks.

Here to understand it much better, we will adopt a four-pronged methodology:
1. **Stratigraphic Analysis** of published excavation reports to trace architectural evolution (Wheeler 1968; Marshall 1931) [15, 7].
2. **Textual Comparison** with the *Manasāra* and *Śulba Sūtras* to identify shared design prescriptions (Kaushish & Kaushish 1994; Chakrabarti 2012) [4, 3].
3. **Comparative Archaeology** with contemporary Near Eastern granary and citadel forms (Legrain 1921; Breasted 1909) [6, 1].

4. **GIS and Satellite Imagery** review for site-wide grid patterns (Rao 1989; Ratnagar 2001) [10, 11].

Through this interdisciplinary lens, we explore Mohenjo-Daro and Harappa's street grids, citadel complexes, public monuments (e.g., the Great Bath and assembly halls), residential typologies, and granaries. We then consider later Buddhist overlays and post-IVC modifications to assess continuity and change.

2. Mohenjo-Daro, Stratigraphy and Urban Morphology

2.1 Site Overview and Excavation History

Mohenjo-Daro literally in Sindhi means "Mound of the Dead". The place occupies a natural island between the Indus River and the western Nara channel (Sahni 1921; Rao 1989) [12, 10]. Early excavations by John Marshall (1922-25) and systematic trenching by R.E.M. Wheeler (1950-53) uncovered seven principal strata of occupation ranging from early mud-brick villages to mature urban phases beneath mounds rising 20-70 ft above the floodplain. Now it is amazing and sad at the same time that due to the flood plains, we have not been able to go much deeper but the initial and modern excavators are sure that there could be same number of layers beneath also. Geophysical surveys and borehole data suggest five to seven additional waterlogged layers awaiting future excavation (Rao 1989) [10].

2.2 Stratigraphic Sequencing and Architectural Evolution

Stratum I to III (Early Mature Harappan, c. 2600-2300 BCE): Emergence of brick architecture, initial street grids, and domestic houses with rudimentary drains (Wheeler 1968) [15].

The investigation and research papers existing shows that the archaeological strata corresponding to the Early Mature Harappan phase (conventionally dated to approximately 2600-2300 BCE) gives us an elaborate but a bit hazy picture of slow and steady occupation levels along with which the level of engineering also kept transforming but still following the ideas and principals of Vedic texts. For example, the systematic adoption and widespread deployment of standardized baked clay bricks as the primary construction material. These bricks, carrying a dimension of the ratio of 1:2:4 (Thickness: Width: Length), probably shows a distinct phase of advancement of architecture where standardization had come into play. This uniformity enabled not only the rapid and efficient erection of structures but also ensuring a high degree of structural integrity. This capability facilitated the construction of elaborate and strong structures with perimeter walls, elevated platforms, and foundational elements, which formed the backbone of the evolving urban landscape.

Concurrently with these material innovations, evidence strongly suggests the planned implementation of a rudimentary, yet discernible, rectangular urban layout. Broad, rectilinear thoroughfares served as primary arteries, meticulously planned to intersect at precise right angles, thereby initiating the grid-like street plan that would become a defining characteristic of later, fully developed Mature Harappan cities. This emergent street network, though potentially less complex than its successors, established a foundational framework for organized settlement growth. Within this nascent urban planning, domestic dwellings were systematically arranged. These residential units, displayed a wide range in size from modest two-room structures definitely made to suit smaller households to more complex multi-chambered houses accommodating larger or perhaps multi-generational families, were typically aligned in contiguous rows alongside lanes branching off the main road or the 'Rajmarg'.

Crucially, the archaeological record from this period also indicates the pioneering integration of basic sanitary infrastructure. Each domestic residence incorporated a simple yet functional drainage outlet, designed to channel household wastewater directly into common street drains positioned beneath or alongside the public circulation spaces. This represents one of the earliest documented instances of planned municipal sanitation infrastructure in South Asia, signifying a collective effort towards managing waste on a community scale. Collectively, these architectural and urban planning innovations, the standardized materials, the planned street grid, the systematic residential arrangement, and the nascent drainage system, are highly indicative of a burgeoning societal concern for both civic order through planned development and the promotion of hygienic living conditions. This crucial phase thus laid the essential architectural and organizational foundations that were prerequisite for the emergence and flourishing of the sophisticated, large-scale urban centres characteristic of the subsequent Mature Harappan period.

Stratum IV-V (Late Harappan Transition, c. 2300-2100 BCE): Standardization of brick sizes (1:2:4 ratio), expansion of citadel precincts, and first appearance of monumental public baths (Marshall 1931) [7].

This period is also marked by a new change in terms of society transformation of next level of living and getting in respecting nature or simply advent of religion. The new design system driven by a well-structured society would be standardization implemented in the production of baked-brick modules.

Now coupled with these material standardizations, the nature and form of the citadel precincts underwent radical changes. Earlier the lanes and by lanes may have been comparatively raised above the surrounding ground level, they carried real deep drains. These new city layouts were now substantially fortified. This expansion involved the systematic increase of existing earthen mounds through the application of successive, extensive layers of precisely laid brick revetment and the construction of imposing earthen ramparts. These efforts clearly demarcated an expanded, elevated zone explicitly reserved for key societal functions: storage places for precious items, a well-protected from floods the grain houses, administrative governance, ritualistic activities, and the residential quarters of the elite like Sethi's. The sheer scale and imposing nature of these enlarged citadels, evidenced by their massive terraces and buttressed retaining walls, serving as a powerful architectural testament. They reflect an increase of political style and an influence of some authority within these boundaries and underscore the growing ritualistic and symbolic centrality assigned to these elevated areas within the urban hierarchy.

Furthermore, this transitional period is notable for witnessing the famous and monumental public bathing installations. These were not simple pools but sophisticated

architectural complexes featuring large pools meticulously constructed and engineered to be waterproof, often utilizing bitumen layers and fine plaster finishes. These pools were typically enclosed within elaborately plastered chambers and accessed by broad, often processional, stairways. The iconic structure known as the "Great Bath" at Mohenjo-Daro stands as the prime example of this innovation. The introduction of these monumental bathing installations represents a new civic typology: Dedicated communal spaces designed specifically for water-based rituals and hygiene 'with continuous running water'. They effectively combined the practical requirement of public cleansing with opportunities for collective ceremonial observance. This system actually marked three key developments the widespread implementation of standardized practices i.e. standard brickwork, the substantial enlargement and fortification of citadel precincts, and the creation of complex monumental public bathing facilities. These architectural achievements collectively signal that Late Harappan society, during this specific phase, had attained both the necessary technical prowess in planning and engineering and the requisite level of social organization, coordination, and centralized authority required to conceive, fund, and execute grand-scale public works on a previously unprecedented scale, defining the pinnacle of their urban architectural legacy.

Stratum VI-VII (Post-Mauryan to Buddhist, c. 3rd century BCE-5th century CE): Overlay of Buddhist stupas and monastic cells, partial reuse of brick platforms for religious architecture (Sahni 1921) [12].

During this period, the archaeological record at Mohenjo-Daro and Harappa exhibits a pronounced transformation of earlier urban structures getting destroyed, damaged and converted into Buddhist religious complexes. Here, the lofty Harappan brick platforms originally erected to support administrative and civic structures were selectively retained and adapted as foundations for stupas and associated monastic cells. Excavations reveal that these brick terraces were overlaid by hemispherical stupa cores and circumambulatory pathways, while contiguous rooms, aligned with the cardinal axes of the former citadel, served as monk's quarters and assembly halls (Sahni 1921) [12]. In many instances, masonry courses from the Harappan phase remain visible beneath plastered Buddhist walls, attesting to an economy of material reuse and the enduring sacrality of elevated sites. This stratigraphic continuity underscores a diachronic reverence for pre-existing sacred topography and demonstrates how Buddhist patronage both preserved and repurposed the architectural legacy of the Indus cities for new ritual functions. Changes in brick-bond patterns, mortar composition, and drainage alignments reflect shifting priorities from ritual alignment to hygienic efficiency (Possehl 2002) [9].

2.3 Street Grid and Vedic Alignment

Mohenjo-Daro's orthogonal grid i.e. East Street (E-W) intersected perpendicularly by First Street (N-S) creating uniform urban blocks (Kenoyer 1998) [5]. While the *Manasara* prescribes cardinal orientation of ritual *vedi* and temple sanctums to align human activity with cosmic forces (Kaushish & Kaushish 1994) [4], Mohenjo-daro extends this principle to secular space. High-quality baked-brick pavements, crowned to shed rainwater, and covered drains at strategic intervals demonstrate a civic commitment to purity echoing Vedic concerns for ritual water (Śatapatha Brāhmaṇa 4.1.1).

GIS analyses reveal minor deviations from true cardinality (±2°), suggesting practical adaptation to topography and prevailing winds. These slight angular offsets may reflect Vedic emphasis on harmony with nature (ṛta) rather than rigid geometric dogma (Chakrabarti 2012) [3].

2.4 Citadel Complex: Sacred-Administrative Nexus

The citadel mound, rising ~12 m, forms Mohenjo-daro's administrative and ritual core. Key structures include:

- **Great Bath:** A 12 m × 7 m octagonal-roofed pool with bitumen-lined underlay, approached via broad steps, flanked by changing rooms and water channels (Wheeler 1968) [15]. Its waterproofing parallels Vedic tank-lining methods for fire-hollow immersion (Agnicayana rites, *Śulba Sūtras*).
- **Assembly Hall:** Measuring c. 27 × 9 m, supported by 20 baked-brick piers arranged in staggered rows (Sahni 1921) [12]. The hall's orientation and pier spacing recall Vedic *vedi* precincts' modular layout.
- **Guild Quarters:** A 70 m × 24 m block north of the great bath, comprising uniform rooms and plinths, likely served as merchant-guild offices or *brahmakṣatriya* treasuries (Parpola 1994) [8].

Excavated seal impressions (Harappa Seals, Type 1 bull motif) near these public spaces suggest large scale and integrated ritual-commercial functions (Parpola 1994) [8]. This can be compared with temple or palace practices of today.

3. Water Management and Sanitation

3.1 Covered Drains and Civic Hygiene

Mohenjo-daro's drains constructed with precision-cut bricks, inspection holes at regular intervals, and graded slopes represent the world's earliest large-scale municipal sanitation system (Possehl 2002) [9]. Each house connects to street drains via private branch channels, an arrangement that transcends simple waste removal to embody Vedic ideals of purity and separation of "clean" and "unclean" zones (Śatapatha Brāhmaṇa 2.6.1).

The construction of the primary drainage channels demonstrates a high level of engineering expertise. These main conduits were fabricated using kiln-fired brick of consistently uniform dimensions, meticulously laid with tightly sealed, often lime-based mortar joints. This precision in material selection and construction methodology ensured both the structural integrity of the network beneath the city streets and its essential impermeability, preventing seepage. Critical for maintaining the system's functionality were strategically placed, regularly spaced vertical shafts, providing circular access points for routine inspection, cleaning, and repair. Furthermore, the entire network was designed with carefully calculated gradients, leveraging gravitational principles to facilitate the continuous, efficient flow and removal of domestic and potentially industrial effluent safely away from the densely populated habitation zones.

This system was an engineering marvel of its times and was not in practice anywhere else. Private branch drains connected each private homes directly to the principal municipal network, allowing for the systematic discharge of

household wastewater and waste into the main underground channels. The systematic separation of 'clean' living spaces from 'unclean' effluvia, particularly water-borne waste, resonates strongly with later documented Indo-Aryan concepts of ritual purity and pollution, as articulated in foundational texts like the Śatapatha Brāhmaṇa (2.6.1). These traditions emphasized the meticulous delineation between pure and impure elements, often associating contamination with bodily discharges and their associated fluids. Consequently, the sanitary installations at Mohenjo-daro may be interpreted not merely as a triumph of practical urban planning and engineering, but also as a tangible, material expression of deeply ingrained cosmological or socio-religious principles concerning cleanliness, order, and the demarcation of sacred or pure space within the urban and domestic environment.

3.2 Wells, Reservoirs, and Ritual Baths
Over 700 wells brick-lined and regularly spaced provided potable water. The Great Bath, along with smaller public tanks, may have doubled as ritual cleansing sites. Vedic texts (e.g., Ṛigveda 6.16) extol the life-giving property of water, a theme architecturally realized in these communal facilities.

4. Residential Architecture
4.1 House Typologies and Courtyard Planning
Excavations reveal three principal house types (Marshall 1931; Wheeler 1968) [7, 15]:

1. **Simple Cottages (c. 4 × 2 m):** Two-room plan with attached latrine draining into street channel.
2. **Intermediate Dwellings (c. 8 × 6 m):** Central courtyard, 3-4 rooms, staircases hinting at upper stories.
3. **Elite Villas (up to 26 × 18 m):** Multi-courtyard mansions with formal porticoes, terraced roofs, and internal wells.

Central courtyards provided light, ventilation, and private ritual space analogous to Vedic *maṇḍapa* courtyards around fire altars (Chakrabarti 2012) [3].

4.2 Multi-Storey Construction
Brick-plinth terraces, thickened foundation walls, and evidence of timber beams indicate widespread use of second-storey wooden superstructures. Vedic treatises (e.g., *Vāstu-Vidya* texts) permit multi-tiered buildings when ritual or civic need demands (Kaushish & Kaushish 1994) [4].

5. Granaries and Economic Infrastructure
5.1 Mohenjo-daro Granary Complex
West of the Great Bath, a 45 × 23 m brick podium supports 27 ventilated grain compartments. Concealed ramps and cross-ducts ensure both accessibility and aeration vital for long-term storage in a subtropical climate (Wheeler 1968) [15].

5.2 Harappa and Lothal Granaries
- **Harappa:** Twelve-unit granary (9,000 ft²) with central aisle, equidistant partitions, and water-way access from the Ravi riverbank, suggesting canal-based logistics (Wheeler 1968) [15].
- **Lothal:** Dock-side granary with twelve 12 × 12 ft blocks and 3.5 ft. interstitial air channels, its timber superstructure burnt but inferable from charred seals (Rao 1989) [10].

5.3 Comparative near eastern parallels
Mesopotamian texts record granaries financing thousands of labor days (Legrain 1921) [6], while Egyptian treasuries stored temple and royal tribute (Breasted 1909) [1]. The IVC granaries' positioning within fortified citadels parallels the temple-palace granaries of ancient Sumer, highlighting a shared Bronze Age economic logic.

6. Harappa: Complementary Architectural Insights
6.1 Site Layout and Citadel
Harappa's citadel mound (c. 18 m high) overlooks a planned lower town. Excavations by Daya Ram Sahni (1921) [12] and Wheeler (1953) [14] reveal:

- **Citadel Barracks:** A 75 × 24 m complex with cell-like rooms, possibly for guards or artisans, connected by brick-paved corridors.
- **Assembly Courtyard:** A central courtyard, formerly 33 ft², flanked by multi-story chambers and porticoed verandas.

6.2 Temple-Palace Structures
A massive 75 × 45 m building with 136 rooms once compared to Mesopotamian shrines features ring-stones and cone-stelae suggestive of phallic and yoni worship (Sahni 1921) [12]. Its spatial arrangement mirrors *manasāra* prescriptions for temple *garbhagṛha* and circumambulatory corridors (Kaushish & Kaushish 1994) [4].

6.3 Residential and Funerary Architecture
Harappa's houses display similar courtyard and drainage plans to Mohenjo-Daro but incorporate funerary jars and cremation pits rituals described in *Gṛhya-Sūtras* (Chakrabarti 2012) [3]. Cell-like bath-rooms with gabled roofs reinforce the centrality of water rites.

7. Buddhist Overlays and Later Adaptations
From the 3rd century BCE onward, both cities saw Buddhist stupas and viharas atop earlier precincts. At Mohenjo-Daro, repeated rebuilding of a brick stupa altered original symmetries, yet continued use of the citadel as a sacred center (Sahni 1921) [12]. These layers illustrate the persistence of elevated platforms and water-related ritual in Indian sacred architecture.

8. Integrative Discussion
1. **Continuity of Sacred Grammar:** Cardinal grids and raised platforms echo Vedic cosmic alignments even as they adopt civic functions.
2. **Ritual-Commercial Synthesis:** Great Baths and assembly halls served communal purification and contract-sealing purposes under guild oversight (Parpola 1994) [8].
3. **Evolution of Domestic Ritual:** Courtyard houses integrated private water rights, a domestic counterpart to public baths.
4. **Granaries as Civic Temples:** State-controlled grain stores functioned as economic temples, safeguarding communal sustenance.

This synthesis demonstrates that the IVC's architectural vocabulary was a living continuation of Vedic spatial ideals mutated by the pressures of commerce, hygiene, and social

stratification.

9. Methodology and Sources

This research synthesizes:

- **Primary Excavation Reports** (Marshall 1931; Wheeler 1968; Sahni 1921) [7, 15, 12].
- **Textual Treatises** (*Manasāra*, *Śulba Sūtras*).
- **Comparative Analysis** with Mesopotamian (Legrain 1921) [6] and Egyptian (Breasted 1909) [1] granaries.
- **GIS Mapping** of site plans and satellite imagery (Rao 1989; Ratnagar 2001) [10, 11].

Limitations include incomplete stratigraphic data for waterlogged lower layers and challenges in correlating textual prescriptions with archaeological evidence.

10. Conclusion and Future Directions

Mohenjo-Daro and Harappa embody a remarkable architectural dialogue between Vedic cosmology and Bronze Age urbanism. Their citadels, baths, grids, and granaries articulate a spatial grammar that is both sacred and secular. Future work should target:

- Under-water Excavations to reveal deeper stratigraphy.
- 3D Reconstructions linked to Vedic texts for experimental archaeology.
- Decipherment of Seals through Vedic linguistic frameworks (Parpola 1994) [8].

Such research will further illuminate how the “silent” seals and stone of the Indus world carry forward the legacy of Vedic order speaking across millennia in the shared language of gods and merchants.

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