A Glimpse of Geometric Patterns Observed in Harappan Town Planning and Pottery Designs

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Abstract: The Harappan Civilization was characterized by a great degree of standardization in its town planning, craft activities and technology. These high degrees of standardization in the past have led to scholars greatly debating on the administrative machinery and high levels of centralization. The present paper here attempts to highlight the knowledge of geometry and their execution by the Harappans which was perhaps the prime mover for achieving such high degree of standardization.

Keywords: Harappan Civilization, Standardization, Geometry, Fortifications, Town Planning, Pottery, Paintings

Introduction
Harappan Civilization is one of the foremost of the world civilizations that thrived during the Bronze Age. Geographically, at its peak it covered parts of modern Afghanistan, Pakistan and Western India and may have supported a population of over five million. The civilization was characterized by its own rhapsody and exhibited a great degree of standardization in its settlement pattern, town planning, craft activities and technology. This high degree of standardization observed in their remains and material relics has often led to questions as to how they were achieved in a period where the existences of centralization were difficult to imagine. In the light of the aforesaid background, the present paper attempts to highlight significant patterns based on basic geometric features that can be observed in the town planning and designs and motifs that can be observed in pottery traditions of the Harappans.

Geometry and Patterns
The well laid out street plans of the Indus cities and their relatively accurate orientation along the cardinal directions have been taken as evidence that the Indus people had at least a working knowledge of geometry (Amma 1979; Parpola 1994). Earlier studies have suggested that Harappans not only had a practical grasp of measurement but also they had an understanding of the basic principle of geometry (Kulkarni 1978). The discovery of scale and instrument for measuring length in different Indus sites indicate that Harappan knew how-to make accurate spatial measurements (Vij 1984;
Balasubramanian and Joshi (2002) for example an ivory scale discovered at Lothal (in western coast of India) has 27 uniformly spaced lines corresponding to 1.70mm (Rao 1985). The sophistication of the metrology practiced by the Indus people is attested by the sets of regularly shaped artifacts of various size that have been identified as constituting a system of standardized weights. There is surprising degree of the uniformity in the widely dispersed centers of the civilization, indicating an attention towards achieving a standard system of units for measurements.

However, most of the studies on the subject of Indus geometry have primarily been concerned with the patterns occurring at macro scale for building plans, street alignment etc. and geometric patterns observed on seals. Designs and motifs on pottery however have been seldom studied and incorporation of evidence from all proxies can lead to a better understanding of the knowledge of geometry known to the Harappans.

**Town Planning**

The town planning of the Harappans largely depended on the area available and location of the settlement for occupation. The settlements were based closed to a water course, either a nullah or river; along trade routes or close to viable agricultural land and/or to raw material source. The settlements were mostly fortified, usually covering the whole area under occupation or in some cases with multiple fortifications dividing the settlement into upper, middle and lower town as seen in Dholavira. The important roads are laid out along cardinal directions with slight deviations of up to 15 degrees and cut each other at right angles. Besides wide roads and lanes another significant feature of Harappan town planning is the creation and maintenance of water bodies for civil and religious purposes. The Great Bath at Mohenjodaro, drains at Kalibangan, tanks and dams at Dholavira, a moat at Banawali are significant examples for water management observed in Harappan cities (Figs. 1-6). With such elaborate features visible, one wonders whether the Harappans had a scaled map of their proposed towns/cities before actually setting up their township. Such systems require more than elementary knowledge of geometry.

However, no maps have so far been recovered from any of the Harappan sites and thus it becomes significantly difficult to provide evidence for such practices, although an examination of town planning of the major Harappan settlements do support such practices.

**Pottery Designs and Motifs**

Harappan pottery is one of the finest potteries manufactured in the Indian sub-continent. It is made of extremely fine, well levigated clay free from impurities and is uniformly well fired. The surface is treated with a slip over which designs are executed in black and sometimes in red. The bulk of Harappan pottery forms are typical and are confined to Harappan site only. Among these the ‘S’ profile jar which is very lavishly painted, cylindrical jar, the stemmed goblet, vessels, bowls, beakers are most prominent pottery forms. The painted patterns are rich in variety and are characterized
by circular, fish scale, pipal leaf, loops, triangle and zigzag motifs etc (fig. 7). Although there is a striking uniformity of fabrics in the Harappan region, a few forms were confined to a particular region, for instance the stud handled bowl which is seen in the Gujarat region only. This ware has quite an individual appearance, distinct alike in fabric and form. The set operations that are required to generate the shapes and designs described above suggest that the people of the Indus Civilization were reasonably aware with the geometry of circular shapes and techniques of their execution. A few of the prominent shapes and patterns found on the pottery are discussed below.

**Circle**
The first simplest and most perfect figure is the circle (Proclus 1992). The reason for the primacy of the circle in Indus geometry is probably not hard to understand if we focus on the technical shapes which are very difficult to execute, without the help of instruments that aid in drawing lines at right angle to each other. Mackay (1938) who excavated Mohenjo-Daro between 1927 and 1937 expressed surprise on finding that “an instrument” was actually used for this purpose (drawing circle) in the Indus valley as early as 2500 BC. In this context, it may be noted that later excavations at Lothal have unearthed thick, ring like shell objects with four slits each in two margins that could have been used for the same purpose (Rao 1985). The simplest variation of the basic circular patterns have two layers of such close packed lattices of circle, with one layer displaced by a length equal to the radius of a circle. In this context, it is observed that one of the signs that occur frequently in the Indus seal inscriptions is the form of two overlapping ellipses. Parpola (1994) suggests an association of this sign with the Pleiades star system. It is a matter of conjecture whether the design of intersecting circle found in so many Indus artifacts has any astral significance.

**Fish Scale**
The next variation seen in the imbricate pattern having regularly arranged overlapping edges resembles fish scales.

**Lines**
Horizontal or Oblique lines, where the band is thicker than the line depending upon the thickness of the latter are sometimes painted in the neck and rim portion of the pottery.

**Zigzag and Wavy Lines**
Zigzag and wavy lines found on the pottery may be indicative of a river or a mountain. Such motifs are useful and probably used for covering large space as fillers and as a divider of multiple scenes.

**Triangle**
Triangle is a basic geometric form and their depictions on pottery may represent either hills or hillocks. Triangles are either in locked hatched or merely in liner positions. It
was probably used for blocking half of the diagonally listed bisected square or to generate other motifs by using two or more triangles such as the double axe or butterfly motif.

**Square**

Square is represented as secondary motifs, usually to enclose motifs like sun or floral designs. They may have served the purpose of space filler.

**Diamond**

Diamonds or lozenge patterns are depicted either vertically or horizontally. These are generally used as bands as borders drawn either vertically or horizontally or even as a series.

![Figure 1: Site Plan, Lothal (Courtesy: Rao 1979)](image)
Figure 2: Site Plan, Kalibangan (Courtesy: Lal 1998)
Figure 3: Site Plan, Dholavira (Courtesy: Bisht 1989)

Figure 4: Site Plan, Banawali (Courtesy: Bisht 1994)
Figure 5: Site Plan, Surkotada (Courtesy: Joshi 1990)

Figure 6: Reconstruction of Great Bath (After Wheeler 1966)
## Conclusion

In a nutshell it is imperative to examine and effectively incorporate these evidences to better understand the origin and development of the Harappan Civilization. Elements such as knowledge of geometry and its execution may have had played a significant contribution in leading to the aesthetic development of Harappan crafts and their town planning and their standardization. In the light of the above it is possible that these traditions were known and effectively applied by the Harappans.

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## References