International Journal of Research in Social Sciences
Vol. 8 Issue 3, March 2018
ISSN: 2249-2496 Impact Factor: 7.081
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

GEOMETRICAL KNOWLEDGE IN INDUS VALLEY CIVILIZATION

DR. NISHANT KUMAR
U.H.S PRAHLADPUR, MUSHAHRI, MUZAFFARPUR

Abstract

We have looked into trace of Geometrical knowledge in Indus Valley Civilization (3500-3000 B.C.) as well as in Vedas and other ancient Hindu Epics thousands of years before Christ. We first discuss the trace of geometrical knowledge in the Indus Valley Civilization. From the archaeological excavations of the cities, Mohenjo-daro and Harappa in Indus Valley Civilization, we find traces of well planned drainage system, road crossing at right angles and big buildings built of burnt bricks. The zoning of the city in bazaars, temple area, houses of the rich and of the menials etc. indicate planning, pre thinking on the part of the city-fathers. We also find the geometrical knowledge preserved in Seals and Plates obtained from excavations. From the figures on seals we can infer that the people of Indus Valley Civilization were well acquainted with rectilinear figures and circles. They also knew the methods to how draw them. These seals are perfect squares or rectangles. The people of Indus Valley also have the knowledge of the relation between volume, weight and density of the material. All the above discussed achievements of the Indus Valley people lead us to conclude that the knowledge of geometry and mensuration must had been in state of developed stage at the time of Indus Valley Civilization in the vicinity of 3500 B.C.

Introduction

The earliest known urban Indian culture was first identified in 1921 at Harappa in the Punjab and then, one year later, at Mohenjodaro, near the Indus river in the Sindh. Both these sites are now in Pakistan but this is still covered by our term "Indian mathematics" which refers to mathematics developed in Ancient India, i.e. in the Indian subcontinent. The Indus civilization (or Harappan civilization as it is sometimes known) was based in these two cities and also in over a hundred small towns and villages. It was a civilization which began around 3500 BC and survived until 1700 BC or later. The people were literate and used a written script containing around 500 characters which some have claimed to have deciphered but, being far from clear that this is the case, much research remains to be done before a full appreciation of the mathematical achievements of this ancient civilization can be fully assessed.

We often think of Egyptians and Babylonians as being the height of civilization and of mathematical skills around the period of the Indus civilization, yet VG Childe in New light on the most Ancient East (1952) wrote:-

India confronts Egypt and Babylonia by the 3rd millennium with a thoroughly individual and independent civilization of her own, technically the peer of the rest. And plainly it is deeply rooted in Indian soil. The Indus civilization represents a very perfect adjustment of human life to a specific environment. And it has endured; it is already specifically Indian and forms the basis of modern Indian culture.

International Journal of Research in Social Sciences
Vol. 8 Issue 3, March 2018
ISSN: 2249-2496 Impact Factor: 7.081
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

The geometrical knowledge of Indus Valley Civilization is available through the archaeological excavation of the cities of Mohenjodaro, Harappa and others. Alphabets of the language used by the Indus Valley people are full of mystery yet remains unsolved, so literary evidence is not available about the state of knowledge of geometry of the Indus valley civilization. Hence, we are required to ascertain the state of geometrical knowledge of Indus people on the basis of the evidence of the findings obtained through archaeological excavations of these cities.

Weights and Measures in Indus Valley Civilization:-

We do know that the Harappans had adopted a uniform system of weights and measures. An analysis of the weights discovered suggests that they belong to two series both being decimal in nature with each decimal number multiplied and divided by two, giving for the main series ratios of 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200 and 500. Several scales for the measurement of length were also discovered during excavations. One was a decimal scale based on a unit of measurement of 1.32 inches (3.35 centimeters) which has been called the "Indus inch." Of course ten units is then 13.2 inches which is quite believable as the measure of a "foot". A similar measure based on the length of a foot is present in other parts of Asia and beyond. Another scale was discovered when a bronze rod was found which was marked in lengths of 0.367 inches. It is certainly surprising the accuracy with which these scales are marked. Now 100 units of this measure is 36.7 inches which is the measure of a stride. Measurement of the ruins of the buildings which have been excavated show that these units of length were accurately used by the Harappans in construction.

To measure length at Mohenjodaro, a rule which consists of a slip of a shell marked with division of 0.67 cm (0.264 inch) was discovered. The mean error of graduation is only 0.00762 cm (0.003 inch) on this scale. The basis of graduation is decimal system. The shell used for this purpose was excellent because it could neither wrap nor expand or contract in varying temperatures. This shows the high level accuracy in mensuration developed as well as the care that has been devoted to maintain that accuracy.

Geometrical Figures Depicted on Ancient Pottery in Indus Valley Civilization.

There is little known about the history of Indian mathematics; this is due to a small amount of authentic records containing their mathematics. The first known mathematics was preserved in the city Mohenjo-Daro, during the time of the Indus Valley Civilization. The Indus valley civilization is thought to have been settled between 3500 B.C. to 2500 B.C. Mathematics was found everywhere in Mohenjo-Daro from its advanced architecture to its methods of measurement, counting and weighing items. The Indus Valley Civilization rivaled the other great ancient civilizations of its time in both knowledge and architecture styles. Examples of their architectural advancements were their tiled bathrooms, brick buildings, and temples which all required a high level of geometrical understanding.

From the excavations at Mohenjodaro, it has been found a favourite pattern on pottery depicting a series of intersecting circles apparently made by drawing a series of vertical lines to divide the surface of jar into a number of nearly equal panels and scratching circles with a pair of dividers. It has also been found that the other patterns are spheres, circles, two triangles

International Journal of Research in Social Sciences
Vol. 8 Issue 3, March 2018
ISSN: 2249-2496 Impact Factor: 7.081
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

joined at their apexes, two or four hemispheres with their curved edges towards the middle of the pattern, a series of linked triangles with hemispheres filling up with the space and rectangles with four sides incurved.

Remarkable is the comment of E.J.H. Mackay, "It is surprising to find that an instrument was actually used for drawing circles in the Indus Valley as early as 2500 B.C."

Engineering-skill behind town-planning in Indus Valley Civilization:-

From the archaeological excavations of the cities, Mohenjodaro and Harappa in Indus Valley Civilization, we find traces of well planned drainage system, road crossing at right angles and big buildings built of burnt bricks. The zoning of the city in bazaars, temple area, houses of the rich and of the menials etc. indicate planning, pre-thinking on the part of the city-fathers. According to Sir John Marshall (1973), the engineering skill and developed ideas of town-planning of the people of the Indus Valley Civilization is very high. All these achievement of ancient Indus Valley people show that the knowledge of geometry and mensuration must had been in state of developed stage at the time of the Indus Valley Civilization in the vicinity of 3500 B.C.

Geometrical knowledge preserved in Seals and Plates obtained from excavations of Indus Valley:-

From excavations of Indus Valley a large no. of seals and plates obtained and from the figures on seals we conclude that the people of Indus Valley Civilization were well acquainted with rectilinear figures and circles. They also knew the methods to draw them. These seals are perfect squares or rectangle (Mackay, 1948, p. 372). But they are of very small dimensions. The largest seal being only of length 6.858 cm (2.7 inch) plate CXIII. Fig. 444 (Marshall 1973) illustrates the division of a rectangle in four rectangles of equal area. On the same plate (fig 437), two rectangles are shown each of which is divided into 12 small rectangles of equal area. Fig. 432 on this plate shows a rhombus which is divided into four rhombuses of equal area.

Plate CXIV, fig. 516, shows a seal with concentric squares and fig. 528 b illustrates a figure like a Sarva to bhadra plan as given below in fig.1 and 2 respectively.

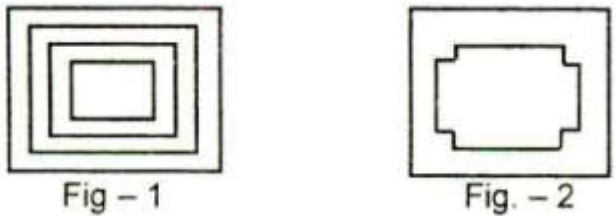

Fig-4.1

In L – area south of Stupa mound. There was a hall of 25.91 square meters (85 square ft.) with a roof supported by 20 rectangular brick pillars with great accuracy in four rows of five pillars each (Mackay 1948, p. 45). At, Harappa we find a building of 51.2 × 43.58 square

International Journal of Research in Social Sciences
Vol. 8 Issue 3, March 2018
ISSN: 2249-2496 Impact Factor: 7.081
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

metres (168 × 143 square ft.) with two series of enclosures each of 15.68 metres (52 ft.), long ranged on either side of a central passage about seven metres (23 ft) in width (Mackay 1948).

The cities of Mohenjodaro and Harappaare known for their rectangular and very precise layout. The above information leads us to conclude that the people of Indus Valley Civilization must have the knowledge of the following postulates and geometrical constructions:

Postulates:-

1. The diagonals of square (or rectangle) divide it into equal areas.

2. The diagonals of square (or rectangle) are of equal length.

This is the standard practice in mensuration to check the accuracy of layouts of a square (or rectangle). The accuracy with which the rectilinear layouts of buildings, big halls etc. are observed, it seems that this postulates might be known at the time of the Indus Valley Civilization.

3. The bisector of the sides of the square cross each other at right angles.

References:-

1. Mathematics in India of the Vedic age, by Dr. R.L. Kashyap.
2. Rig Veda, 1.105.17
3. Krishna Yajurveda [4.7.11]
4. Yajur Veda, 16.54
5. Brihadaranyaka Upanishad, 2.5.10.
6. Atharva Veda, 10.8.24
7. Atharva Veda 5.15, 1-11.
8. LG, P2
9. NDI, P39.