Journal of The Gujarat Research Society

ISSN: 0374-8588
Volume 21 Issue 16, December2019

A REVIEW ON THE NUMERICAL AND THE MEASURING SYSTEM OF THE INDUS VALLEY CIVILIZATION

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ABSTRACT:As empirical measurements focused on numerical values in most developmental stages, the Indus valley civilization was the most ancient advanced civilization. The Indus Valley human progress was a Bronze Age development in the northwestern locales of South Asia, enduring from 3300 BC to 1300 BC, and developed between 2600 BC to 1900 BC.Alongside antiquated Egypt and Mesopotamia, it was one of three early developments of the locale involving North Africa, West Asia and South Asia.In measuring length, mass, and time, the people of the Indus civilization have achieved great accuracy. They were among the first to establish a system of weights and measures that were standardized. Indian numerals were driven from 1 to 13 by the of Indus valley civilization. Ancient mathematics was used for practical purposes in calculation of weights and distances, scaling, fixed proportion adopted to urban structures, architectures, metallurgy etc. in many developmental planning of Indus civilization.

KEYWORDS:Indus valley civilization, Measuring system, Numerical system

INTRODUCTION

The Indus Valley human progress was a Bronze Age development in the northwestern locales of South Asia, enduring from 3300 BC to 1300 BC, and developed between 2600 BC to 1900 BC[1]. Alongside antiquated Egypt and Mesopotamia, it was one of three early developments of the locale involving North Africa, West Asia and South Asia. The most far reaching alongside its locales had crossed a region extending from upper east Afghanistan, through a lot of Pakistan, and into western and northwestern India and prospered in the bowls of Indus River, which courses through the length of Pakistan and along an arrangement of perpetual, generally rainstorm took care of waterways that flowed in the region of the occasional Ghaggar-Hakra stream in northwest India and eastern Pakistan[2]. Bronze Age human progress comprised develop period during 2600–1900 BC, basically focused along the Indus and Punjab district. The development further reached out into the Ghaggar-Hakra stream valley of the district of the Ganges-Yamuna Doab, and including generally in numerous pieces of Pakistan, western most conditions of India, south eastern Afghanistan, and eastern most piece of Baluchistan[3]. The develop period of this progress is referred to as the Harappan human advancement as the first of its Civilization, as the first of its urban communities to be uncovered was the one at Harappa, and exhumed during the 1920s at the hour of Punjab region of British subcontinent. The uncovering of Indus valley development locales have been done as progressing since 1920, with significant discoveries happening as of late as Mohenjo-Daro, an UNESCO World legacy site.

DEMOGRAPHY

Journal of The Gujarat Research Society

ISSN: 0374-8588
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The Indus valley progress enveloped the greater part of Pakistan, reaching out from Baluchistan to Sindh, and stretching out into present day up to Indian conditions of Gujarat, Rajasthan, Haryana, and Punjab, with an upward reach to Rupar on the upper on the upper Sutlej. There is proof of dry waterway beds covering with the Hakra divert in Pakistan and the occasional Ghaggar stream in India. Numerous Indus valley or Harappan destinations have been found along the Ghaggar-Hakrabeds.As indicated by certain archeologists, more than 500 Harappan locales have been found along the evaporated waterway beds of the Ghaggar – Hakra stream bowl and its feeders. The Harappan destinations around 100 along the Indus and its stream bowl feeders by and by as stays in sorts of significant locales of the Indus valley progress.

NUMERICAL AND MEASUREMENT SYSTEM

Many significant advancements in technology were made by the people of the Indus river valley civilization, including great precision in their numerical systems and length and mass measurement methods. Baked bricks under urban fire architecture was found to be uniform in size and resistant to humidity and was used in the construction of baths and sewage structures. Their scientific assessment showed that Harappans were among the first to develop a system of Measures and uniform weights. As the earliest scientific-based measurement device, the continuity of brick size across cities also indicates unity across the different urban areas, which is evidence of a larger society.

The oldest proof of Indian's mathematical understanding is found in the civilization of the Indus valley. In the excavations of Mohenjo-Daro and Harappan, the seals and pictographic inscriptions found suggested that the people of this civilization had knowledge of numbers. The Harappan society was the womb of mathematics, from which both the idea of numbers and the numerical method came into being. The numerical method that was first to be employed by the Harappan which later on found its way into another ancient civilization. The earliest use of mathematics was in the Indus Valley in the Indian subcontinent and dates back to 3000 BC.

The earliest known Indian urban scientific culture was in the Punjab at Harappa and near the Indus River at MohenjoDaro. A uniform system of weights and measures was adopted by the Harappans[4].Harappans used a decimal numeral system without a value system of zero and position. The Indian numerals of the Indus Valley Civilization of 3500 B.C. were driven by numbers. These are the numbers in the Indus Valley civilization from 1 to 13[5].In several developmental planning of the Indus civilization, ancient mathematics was used for practical purposes in calculating weights and distances, scaling, fixed proportion adopted to construct bricks, etc. The thorough study showed that weights corresponding to 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, and 500 ratios were used. The presence of a graduated system of correctly marked weights illustrated the numerical system-based growth of trade in Harappan society.

Some instruments for the calculation of length have also been found. A remarkably precise decimal rule known as the positions of MohenjoDaro is quite important. The maximum error of its numerical subdivision is just 0.0055 a t a length of 1.32 inches inches. The length was called the inch of Indus. When a bronze rod was found along with marked lengths of 0.367 inches, another measuring scale was discovered. The precision of these scales was marked by 36.7 inches in 100 units of this test, which was the measure of a move. During the

ISSN: 0374-8588
Volume 21 Issue 16, December2019

excavations at the Indus sites, a number of scales were found to measure the length.A decimal scale known as 'Indus Inch' was found to be based on a 1.32 inch (3.35 cm) measurement unit. A bronze rod labeling 0.367 inches was discovered on another scale. It is postulated that these measurements were used with great precision by the Indus people in buildings and other urban structures.

Decimal method had been used by the citizens of Mohenjo-Daro time as linear measurement revealed that standardized units of length were used in town planning along with calibrated to around 1 D 16 inch (1.6 mm) made in the planning of cities. The Indus Valley civilization made use of ivory. Measurements of the ruins of buildings excavated from various sites in the civilization of the Indus valley showed that these units of length were precisely determined.Used in construction by the Harappans. In measuring length, mass, and time, the people of the Indus valley civilization achieved great precision. They were among the first to establish a system of weights and measures that were standardized.A comparison of available artifacts suggests wide differences in size across the territories of the Indus. They were among the first to create a system of standardized weights and measures, but from city to city, real weights were not uniform, as in other civilizations of the period. Approximately 1,704 mm was found in their smallest division, which is marked on an ivory scale found in Lothal, and the smallest division ever recorded on a Bronze Age scale. On a scale somewhat similar to the ncialimperial ounce or Greek uncial ounce, the weights were in a perfect 5:2:1 ratio (Sergent, 1997)[6].

In measuring length, mass, and time, Indus valley civilization achieved great precision as the first to establish a system of standardized weights and measures to be extremely accurate followed the decimal measurement division for all practical purposes, including mass measurement as revealed by their hexahedron weights. These chert weights were used in a perfect 5:2:1 ratio with weights of 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200 and 500 units, each of which weighed approximately 28 grams per unit.The decimal division of measurement was adopted by Harappan engineers for all practical purposes, including mass measurement, as shown by their hexahedron weights in all development planning, architecture, metallurgy, etc.In the Vedic period, Indian geometry has had its origins. The theorem of 'Pythagoras' was defined by Baudhayana and others in Sulbasutra. At the time of Pingala'sChhandahshastra, about the fifth century, binary numbers were identified. These chert weights were in the 5:2:1 ratio, weighing 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200 and 500 units, weighing approximately 28 grams per unit, equivalent to the ncial imperial ounce or Greek ncial, and weighing smaller items in the same ratio w ith 0.871 units. Nevertheless, as in other cultures, actual weights were not standardized throughout the country. The weights and scales later used in the Arthashastra of Kautilya are the same as those used in the Indus valley civilization's Lothal sites.

E.J.H. Mackay, who excavated Mohenjo-Daro between 1927-1932, expressed surprise that an instrument was actually used as early as 2500 BC, drawing circles in the Indus valley (Mackay, 1938). It should be noted in this context that subsequent excavations at Lothal have uncovered thick, ring-like shell artifacts, each with four slits in two margins, which could have been used to calculate angles on plane surfaces (Rao, 1985).Indus cities' well-designed street plans and their exact alignment along the cardinal directions have long been taken as proof that the Indus people had at least a working knowledge of geometry based on numerical angles (SarasvatiAmma, 1979; Parpola, 1994)[7][8]. Earlier mathematical research suggested

ISSN: 0374-8588
Volume 21 Issue 16, December2019

that not only did these individuals conduct realistic calculation applications based on length and width, but that they also grasped the fundamental concepts of geometry [9].

The discovery of scales and length measurement tools at various Indus sites shows that Indus culture knew how to make precise spatial measurements in urban planning in compliance with the architectural rules. An ivory scale discovered on the western coast of India at Lothal has 27 uniformly spaced lines over 46 mm, suggesting a unit of length equal to 1.70 mm[8]. Different sets of square circles reported the complexity of the geometrical practiced by the Indus individuals.Geometric knowledge of the Indus civilization has shown that about 443 regularly formed objects of different sizes have been recognized as a standardized number and weight measurement method. Indeed, in the measurement units used in the widely distributed centers of the Indus civilization, there is a surprising degree of uniformity, suggesting that the scientific revolutionary phases were developed to achieve an ancient standard system of measurement units during the Indus valley civilization period.While on the evidence of these measurement inscriptions, the Indus valley civilization is generally described as illiterate culture, and this definition has been questioned by Farmer et al. (2004) argued that the Indus system did not encode language, but was instead similar to a variety of non-linguistic signs as the measurement system was commonly used in most developmental phases.

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