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# Geometry from vedic rituals to school mathematics: Postulates and content

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**Abstract**
This article explores the geometric knowledge from the Sulba Sutra and its relevance to school geometry using historical research methods collecting historical documents and analyzing them. Key assumptions, theory, theorems and practices were taken from Vedic texts Sulba Sutra and school mathematics texts. It examines key assumptions (Postulates) of Vedic ritual geometry, such as the construction of altars using precise proportions, alongside the Jatya Tribhuj (early right-angled triangle) and the Bhoja Koti Karna Nayana (Sulba theorem on right-angled triangles). Additional topics include shape transformations, symmetry, and the use of mean proportion. The research traces the mathematical content in various Sulba Sutras and their historical development. Similarly, a correlation of contents in school mathematics was established logically.
The study concludes that Vedic ritual geometry's principles align with fundamental school geometry topics. Incorporating these concepts into school curricula can enhance students' engagement and understanding by linking abstract mathematical ideas to historical and cultural practices. This approach promotes hands-on, inclusive learning, blending ancient geometric knowledge with modern education for a culturally responsive teaching framework.

**Keyword:** Vedic geometry, sulba sutra, bhoja – koti - karna – nayana sutra

## Introduction
The word Sulba stems from the root Sulwa means to measure. The etymological derivation of the word can be presented from three ways; act of measuring, instrument of measuring and result of measuring. The Kalpa Vedanga, one of the six Vedangas, consists of four different sections of ritual literature: Shrauta, Dharma, Ghriya and Sulbha Sutras. In the earlier periods Srauta Sutras used to be understood as, "rules governing Sacrificial rites". This is because the Sulba Sutras contain the rites of performing rituals and construction manuals of different Agnikundas for the ritual performances. Now a days the word Sulba is understood as a rope used to lay out Yagyakundas or Agnikundas or Firealters. Siriniva (1967, p. 07) [13] writes that the name “Sulba Sutra is the ancient name of geometry in Vedic Culture. It may be because the Sulba means the chord and all measuring was done using it”.
Datta (1932) [1] has written the four different meanings of the term 'Sulba Sutra' namely mensuration, line or surface, a measure and geometry. According to Datta, mensuration means act and process of measuring; similarly, line or surface means the result obtained by measuring, a measure means an instrument of measuring, and geometry means the art of measuring. Now question arises, why the term Sulba Sutra is used for different meaning connected to measurement? The only answer is that ritual performance activities needed space construction are connected to geometrical shapes and geometrical metric properties are used in construction. This is explained in Sulba Sutra. Hence to perform rituals with the use of geometrical properties is required. For example, construction of square with an of area 576 sq. anguls is basic shape and transforming the area of square into circle and semicircle with maintaining the area equal square are the use of geometrical properties in Vedic rituals. Angul is nonstandard unit of measurement used in Vedic ritual, in which 24 angul is one sixth of the total height of a ritual performer taken from toes to the tip of the middle finger when raised both hands up. According to Datta, Sulba is the measuring tape called Rajju and the word Sulba is used in the sense of “a line.

The word 'Sulba' derived from the Sanskrit root 'Sulab' meaning "to measure" came to mean the chord employed in measuring for the construction of Agni Kunda while performing Vedic rituals. Garjar (1947 P.14) writes that the word 'Rajju' is used in the Sutras to measure the chord but not the word Sulba. Thus, the word Sulba Sutra is interpreted as the science of dealing with the rules of sacrificial rites but not the rule of chord. This shows that the meaning of the word Sulba Sutra is not limited only to the rule of string or Rajju, It contains boarder meaning.

The two Sanskrit words 'Sulba' and 'Rajju' mans a rope or a chord. The root of the word Sulba is 'Sulb' means to measure, so the etymological significance is measuring work related to measurement of things or ground on the earth. The above discussion insights that the word Sulba is used in different works nature like a thing (instrument) to measure, the unit of measurement, result of measurement and consequently a line or surface. Thus, the meanings of the word Sulba can be viewed from four different aspects; Mensuration—the act and process of measuring, line or surface—the result obtained by measuring, a measure—the instrument of measuring, Geometry—the science of measurement.

Mention of a linear measure called 'Rajju' is found in the Apastamba - Sulba, Manava-Sulba, Arthasastra of Kautilya, and later on in the Silpa – sastra. In fact, in ancient Vedic period, there were three kinds of measures—linear, superficial, and voluminal (geometry) with the name Rajju. As Raju is used in all thre kinds of measures, a critical question appears what could be the common ideas that interprete the meaning given in different Sulba Sutras.

Datta (1932, p.20) [1] writes that "each sacrifice must be made in an Agnikunda (Fire alter) of prescribed shape and size. Even a slight irregularity and variation in the form and size of the alter/Agnikundas, will nullify the object of the whole ritual (aim of the ritual) and may even lead to an adverse effect" to the performer. To keep correct shape and size of Agnikunda/alter, the science of size and shape is important to priest who guide the ritual. Sulba Sutras describes the geometric principles to construct place of ritual performance called Vedi, Mandap and Agnikunda.

## Objective of the study

The overarching objective is to search interface between the two geometrical system – The Vedic geometric and school geometry – to figure out the similarity and differences in geometrical ideas and the pedagogical value in integrating Vedic geometrical contents and process in learning school geometry and applications. Elaborating this overarching objective, the following objectives are the focus of the study:

1. To locate the period of development of Vedic geometry and modern school geometry through the analysis of historical documents.
2. To compare and analysis the geometrical shapes, sizes properties used in Vedic rituals as explained in Sulba Sutra and equivalent contents in school geometry.
3. To explicate geometrical system in Sulba Sutra and compare with School Geometry while connecting different shapes and size.
4. To examine the pedagogical value of Vedic geometry integration in teaching of school geometry.

## Methodology

The method is the scientific way by which research systematically gains knowledge about a certain cause and effect issue. Sence there are different texts related to Vedic rituals but Geometrical knowledge used in the ritual of Vedic culture are mentioned on ancient Vedic texts like Sathapatha Bhramana - II, Sulba Sutras and Sanskrit texts Kundamandip Siddhi. This study is based on the ancient texts so based on historical method and explorative in nature.

The above discussion creates some questions like; when the geometry used in Vedic rituals called Vedic geometry developed? What are the geometrical activities on the Vedic rituals found in Vedic texts Sulba Sutras? If the different Agnikundas of prescribed shape is to construct in exact shape and measurement then what are the geometrical shapes to be constructed exactly requires to construction Agnikundas? Does the construction align or differ from the principles of Euclidean geometry taught in the school today? With the objective of finding the answer of the questions the following discussions is made.

## Vedic texts and place of Geometry

Vedic literatures are divides into four strata or layers – Chhandas, Mantras, Brahmana, and Sutra and each stage of development must have lasted, at least for a few centuries before it passed it into the text (Tilak 1925, p.2) [14]. It is mentioned on the ancient Vedic text Sathapatha Bhramana to offer materials on Agni at suitable time ('Sahit or Shuvamuhurtha') when Kritika Nakshtra will appear in the East (Sathapatha Bhramana – II;1ka,2pra,1bra.). This shows that the geometric content mentioned in Vedic text Sathapatha Bramana are dated before Kritika Nakshatra. Dikshit (1957) [2] writes that Kritika Nakshatra. appeared in the east before 1068 B.C. This evidence gives that use of geometry in the Vedic rituals was in practice before 3068 B.C. Agnikundas, are necessary construct in Vedic rituals, need to construct with the side length of square either 24 or 30 or of 36 anguls or multiples of these units (as necessity of the size of Agnikunda)) then transformed other desire shapes. As mentioned on Satapatha Brahmana, while creating fire and placing in Agnikukunda mantras on Gyatri Chhanda of 24 letters is pronounced assuming that the God Agni prefers Gyatri Chhanda. Similarly, Mantras of 36 letter called Brihiti Chhanda, pounced to go heaven because it is believing gods like Gyatri Chhanda to go heaven. Similarly, Mantras on Birat Chhanda are of 30 letters and the mantras of Birat Chhanda are pronounce to maintain prestigious life of the god' society.

The line joining the points at 36 units right and 15 units below from the centre of line joining the four directions: east, west, north and south is of length 39 units (Satapatha Brahmana II;3ka.4 pra,1bra). The Sanskrit texts Kundamandip Siddhi (2017) [6] used the term 'cardinal directions' for the line joining the four directions. Cardinal directions make perpendicular to each other so are as rectangular coordinate axis of modern school geometry. So, the triangle of sides 36 and 15 units along cardinal direction and the third side with 39 units is a right-angled triangle mentioned in the Vedic text (Satapatha Brahmana) because the two sides are along perpendicular lines and third side 39 is hypotenuse can be observed by the Bhuja- Koti - Karna - Nayana Sutra. That is $39 = \sqrt{(15)^2 + (36)^2}$, This right-angle triangle is named as Jatya Tribhuj by Bhaskara II. (1150) on his work Lilawati. This shows that Vedic rituals use geometrical knowledge like perpendicular lines (Cardinal Directions), Right angle triangle and its relations of side length and square of side length anyone of 24,30 and 36 or sub- multiples. This practice on Vedic rituals is from ancient time and documented on the Brahmana before the development of Sutras. The chronology of Mathematics in Vedic era is presented in the following table.

**Table 1:** The chronology of history mathematics vedic era

| Period (B.C) | Main Historical Events | Mathematics | Mathematicians |
|---|---|---|---|
| 3000 – 1500 | The Indus Valley civilizations, Harappa Lothal, and Mohenjo -Daro [Source; archaeological excavations between 1921 and 1923] | Weight, Brick technology influenced the construction of Vedic alters (Agnikundas) in the next period. | |
| 1500 – 500 | Formations of Codes of Manu, Recording of Vedas and Upanishads | Development of Vedangas and Sulba Sutras, Problems of Astronomy, Arithmetical problems, Vedic Geometry | Baudhayana, Apasthamba, Katyayana |

*Source*: (Joseph,2008; page 313 – 314) [5]

As discussed previously with referencing Sathapatha Bhramana – II(1ka,2pra,1bra) and Dikshit (1957) [2], geometry in the Vedic rituals was in practice before 3000 B.C.E., This table also shows the construction of Agnikunda from 3000 B.C. Later mathematicians Baudhayana, Apasthamba, and Katyayana made the sutras simple through elobrations and carried out by their names like Baudhayana, Suba Sutra, Apasthamba, Sulba and Sutra Katyayana Sulba Sutra. Panta (2024) says initially Vedic texts were not reader friendly because of its abstract nature, so to make them readers friendly different authors made commentaries on Sulba Sutras and their commentaries are now a day recognize by their names (Panta, personal communication, April 8, 2024). Next question, what were the contents of geometry in the Suba Sutras? Following table gives the geometrical contents found on Baudhayana Sulba Sutra.

**Table 2:** Topics in Baudhayana Sulba Sutra

| Sanskrit Name | Their English Equivalent Meaning |
|---|---|
| Rekha - mana Paribhasa | Mana means measurement, Rekhamana means length of a part and Rekhamana Paribhasa means units of linear measurement |
| Chaturshra – karano - parya | Sastra means side and Chaturstra means four sides so Chaturshrakaranoparya means Construction of four-sided figure like squares, rectangles |
| Kramnya - yanaya - nam | Karani refers to square root, kramnyayanayanam refers to, how do we find the square root of non-square number |
| Chhetra – kara - parinaama | Area preserving transformation of geometrical figures. For this we need to know the value of Pie. |
| Nana – widhawedi - wiharam | Plan for different sacrificial ground (Darsa, Pasubanda, Sutramani, Agnistoma) |
| Agrina Pramana kshetra - maanam | Areas of the Sacrificial fires (Aagni kunda/ alters) |
| Eestaka Sankhya Pariman - arya kathanam | Choosing clay, sand in making bricks |
| Estako - padhane Getyad - inirya | Process of manufacturing the bricks |
| Estako - padhan Prakara | Describing the shape of Syenaciti |
| Shyena - chidadakara Niru - panam | Describing the shape of Syena citi |

(Ramasubramanian, 2013,18:45) [10]

The table shows geometrical knowledge mentioned in the Sulba Sutra is related to the constructions of square, circle, triangle, rectangle and trapezium and construction of Agnikundas on these shapes. The deformation of one figure in to the other having the area same and to divide the figure into the equal parts was the main principle of Sulba Sutra, because the desired shapes of Agnikundas was constructed with the help of square. Now other concern is tools and the procedures of constructions were practiced then. How straight line is constructed? How its perpendicular constructed? The answer of these questions is mentioned as follows.

> "Same Shanku Nikhaya Shankasimmitya rajjwaa mandalam parilikhya yatra lekhyoh shankgrachhaya nipatati tatra shanku nihanti sa prachi".

(Kathyanaya Sulba Sutra; KSS.1.2)

Explanation: Same (In a horizontal plane), Shanku (stick), Nikhaya (fixing stick), Shankasimmitya rajjwaa (choose a rope of appropriate length) mandalam parilikhya (circle to be drawn taking centre at a pole/stick) shankgrachhaya nipatati tatra shanku nihanti, sa prachi. (Fix a pole on a levelled ground and draw a circle with a chord taking the centre at the pole. Fix pins at points on the line of the circumference where the shadow of the tip of the pole falls. The like joining the two pins is East – west line. Now the line joining the intersection of two circles drawn at the end points of the East – West line is perpendicular line and both are Cardinal directions. Now the construction of squares on the sides and hypotenuse of a square called "Bhuja – Koti – Karna – Nayana" or Sulba theorem as mentioned on different Sulba Sutras are as follows.

> "Dirgha – chaturshas - trasya Akshnaya Rajju: Parswa mani Tiryanga Mani cha yat
> Prithagbhute kurtah tadubhayam karoti"
> (Baudhayana Sulba Sutra; BSS 1.12)

> "Dirghachaturshastrasya Akshnaya Rajjuh Parswa mani Tiryanga Mani Cha Yaat
> Prithagbhute Kurta: Tadubhayam Karoti Iti Kshetra Gyanam"
> (Kathyanaya Sulba Sutra; KSS.2.7)

**Meaning**: Dirgha – chaturshas (Rectangle) Akshnaya Rajjuh (Diagonal rope) Parswa mani (The measure of the lateral side) Tiryanga Mani (The measure of the perpendicular side), prithg – bhute kurata - sta - dubhayam kartoi (divides into two equal parts). The Sutras of given by Baudhayana and Kathayana show that there are only two differences; the phrase "Iti Ksetra Ganam" has been added by Kathayana. This phrase "Iti Ksetra Ganam" means this is the area to be understood. The same topic is mentioned in Manava Sulba Sutra as below;

> "Aayamam aayamam Gunam wiataram wistrana tu Samasya bargamulam yat karna tawdido biduh."
> (Manava Sulba Sutra; MSS 3.3.1.10)

Meaning: Aayamam - aayamam Gunam (The length multiplied itself) wiataram wistrana tu (And indeed, the breadth by itself) Samasya bargamulam (The square root of the sum) yat karna (That is hypotenuse) tawdido biduh (Those versed in discipline say so). Khadikar (1996) mentions the period of Manava Sulba Sutra 650 B.C – 300 B.C. The discussion is of before Edclid (c.320B.C.)

This discussion shows that the Sulba Rule called 'Bhuja – koti – Karna – nayaya' has been clarified by different commentators of Sulbasutras like Baudhayana and Katyayan, Apastamba and Manava in the early Vedic period. Observing the explanations made from Baudhayana to Manava it is clearly reflects that the 'Bhuja – koti – Karna – nayaya' sutra of on Vedic text Sulba Sutra has the same characteristics as today's Pythagorean theorem of school geometry. Verse was a primary medium for encoding mathematical knowledge Eastern Mathematics like Vedic texts Sulba Sutras or works by Aryabhata and Bhaskara. In contrast, western mathematics generally transitioned to prose – based explanations and symbolic notation earlier eastern traditions.

**Propositions of Vedic ritual geometry**

Propositions are the statements that express a judgement or opinion (Dictionary of Oxford Language,2002). In other word they are premise or postulation. In mathematics propositions is a statement that tells relations of different concepts of /variables/constructions, and it is either true or false. Axioms, postulates, theorems, lemma etc are the propositions. All verses are also a proposition in Vasic geometry. The term postulates are directly not used in the geometrical knowledge mentioned in Sulba Sutra. To apply geometrical knowledge in the Vedic rituals, and for the constructions, Gurjar (1947) [4] writes that there should be some assumptions and requires pre - knowledge of geometry. Kulakarmi (2000) [8] writes that Sulba Sutra also gives the principle of Bhumiti (Measurement of Bhumi) and Bhaumitiya (geometrical creates or creations) like shapes, size and number of bricks and information to construct Agnikunda. To construct such geometrical shapes,it requires pre - assumptions on geometrical knowledge requires. The assumptions/ Parakalpana (Axioms) is mentioned in those Sulba Sutras.

**Table 3:** Geometrical Postulates (Bhaumitik Parikalpana) of different Sulba Sutras

| SN. | Mathematical Computations | Reference on Sulba Sutra |
|---|---|---|
| | Bhaumitik Parikalpana is Postulates or axiom of in a context of Vedic ritual works as in Euclidean geometry. | BSS: Baudhayana Sulba Sutra |
| | | MSS: Manawa Sulba Sutra |
| | | ASS: Apasthamba Sulba Sutra |
| | | KSS: Kathyanan Sulba Sutra |
| 1 | A rope can be divided in to equal number of parts. | ASS – 1.13,1.7,1.12,2.2,4.7.7.10,12.11,12.15<br>BSS - 1.30,1.32,1.58 – 60,1.68 – 69,2.64,2.67<br>MSS - 10.1.11,10.1.2.4,10.1.4.7,10.3.3.3<br>KSS - 1.12 -14,1.27,1.29,3.14 |
| 2 | Construction of figures equal in area to given circle with the help of diameter. | BSS – 2.74 - 77 |
| 3 | Construction of figures equal in area to a given square. | BSS - 1.46 – 47,<br>ASS – 3.11 – 12,3.15 – 16,3.19 – 21<br>KSS - 3.6,3.8 - 10 |
| 4 | Diagonal of square and rectangular divides the figure in to two equal parts. | BSS - 1.52,4.41<br>ASS -3.1<br>KSS – 3.4 |
| 5 | Diagonals of Square and rectangle makes four divisions similar figures equal. | BSS - 4.4 |
| 6 | Diagonal of Samachaturvuj [ Square & Rhombus] bisect at right angle. | BSS – 4.111 – 122, KSS – 2.6,<br>MSS - 10.1.2.6 – 7<br>ASS – 6.18 – 19 |
| 7 | Sides of square cuts as right angles. | KSS – 2.6,4.6<br>MSS- 10.1.2.6 – 7<br>ASS – 6.18 - 19 |
| 8 | The vertex of an isosceles triangle if joined to the mid-point of the base divides the triangle in to two similar parts having equal in area | KSS – 3.4.,4.7<br>BSS- 4.62 |
| 9 | The midpoint of side of a square if joined to the opposite angles the triangle so formed is half in area of the square. | BSS 1.56 MSS – 10.3.6.3<br>ASS- 12.8 |
| 10 | The line joining the midpoints of a square is also a square and half in area of the given square. | BSS 1.57 MSS – 10.3.6.4<br>ASS 12.12. – 14<br>KSS – 2.6 |
| 11 | The line joining the midpoints of a rectangle is a samachaturbhuj (square or rhombus) and half in area of the given rectangle. | BSS 1.57 Mss – 10.3.6.4<br>ASS- 12.13. – 14<br>KSS – 4.6 |
| 16 | The area of circle with the length of diameter equal to the diagonal of a square is double of the area of square. | MSS – 10.1.1.8 |

***Source***: [Kul Karni, 2000 [8], Page, xxviii – x xxxv; collection from Baudhayana, Manawa, Apasthamba, Kathyanan Sulba Sutra]

The proof of the propositions of Vedic geometry are demonstrable. Datta writes that; "Each of the propositions of Vedic geometry is demonstrable i.e. demonstration of the results of each statement is possible, but there are no formal proofs as it is done in Euclidean /school geometry by purely using deductive reasoning. In addition, he writes that the geometry used in the Vedic ritual is wholly practical without any semblance of demonstration. Now question comes like; Why the propositions of Vedic geometry (Bhaumitiya Parikalpanas) were not discussed by the mathematicians in the later ages? The following discussion are made about the place of geometrical works on Sulba Sutras.

**Place of Geometrical works in different Sulba Sutra**

Baudhayana Sulba Sutra gives the Bhumiti (Measurement on earth or Bhumi) and configurations to construct different Agni, Mandap and Vedi. Related to content of Sulba Sutra Gurjar (1947) [4] writes that the 'Bhuja – koti – Karna –

nayaya' Sutra is a Sulba Theorem (now wrongly known as Pythagoras theorem) with its accompanying properties. Gajur has not mentioned abut, how Pythagoras developed the theorem? Also, can there may not be same ideas among the people of different time? How Pythagoras triples were defined and why not Vedic geometric triples cannot define? The Sulba Sutras demonstrates the geometric knowledge through techniques like drawing perpendiculars and bisectors, constructing figures with equal areas, and finding mean proportional, which were vital for Vedic altar designs. They provide accurate approximations for values like $\sqrt{2}$ and methods to transform shapes, such as converting a square into an isosceles trapezium or finding circles equal in area to given squares. These contributions highlight the Sulba Sutras' blend of ritualistic, cultural, and mathematical significance, offering valuable insights for modern geometry education. The different chapters and its topic related to geometry in different Sulba Sutras. The following table represents the geometric knowledge mentioned in different Sulba Sutras.

**Table 4:** Geometrical Content in Baudhayana Sulba Sutra

| S.N. | Aadhayas (Chapters) | Description related to the information about |
|---|---|---|
| 1 | Frist | Measure of length unit, configuration to construct different Agni Kundas having Bhaumitiya aakrities (Term rectilinear figures used to denote plain figures.) |
| 2 | Second | Measure to construct square shapes inside circles and their areas for different sized Aagni Cities |
| 3 | Third | Size of two different types of square shaped Shyn citi and measure of bricks to construct it. |
| 4 | Fourth | Measures to construct the different parts like head, wings of Shyn citi (shape of bird) in trivujakar (Triangle) or Samachaturvuja (square or rhombus) shape and measure of bricks to construct it. |
| 5 | Fifth | Measures of two Rathachaktra citi (circular wheel shaped) |
| 6 | Sixth | Measure to construct square shaped Drowna Citi |
| 7 | Seventh | Measure to construct the circular shaped Drowna Citi |
| 8 | Eighth | Measures to construct Shamshan citi in trapezium for |
| 9 | Nineth | Construction manuals of Kurma citi |
| 10 | Tenth | Construction manuals of Kurma citi |

***Source***: [Kulakani, 2003, Pp.1 – 114]

**Table 5:** Geometrical Content in Manaba Sulba Sutra

| S.N. | Chapters | Description related to the information about |
|---|---|---|
| 1 | Shulba | Measurement of construction manuals square shaped of Shyena citi, Kanka citi, Ajal Aagni citis having the area of 7.5 sq. Purusa and Rathachakra citi of 21.5 sq. Purusa. Descriptions manuals to construct brick. Construction manual of circle having equal area in square and rectangles. Description of $\sqrt{2}$. |
| 2 | Utherestak | Measurement of construction manuals square shaped of Shyena citi, Kanka citi, Ajal aagni citis having the area of 7.5 sq. Purusa and Rathachakra citi of 21.5 sq. Purusa..Descriptions manuals to construct brick. Construction manual of circle having equal area in square and rectangles. Description of $\sqrt{2}$. |
| 3 | Waisnaw | Measurement of construction manuals square shaped of Shyena citi, Kanka citi, Ajal aagni citis having the area of 7.5 sq. Purusa and Rathachakra citi of 21.5 sq. Purusa..Descriptions manuals to construct brick.Construction manual of circle having equal area in square and rectangles. Description of $\sqrt{2}$. |

***Source***: [Kulakarni ;2003, Pp.127 – 203]

**Table 6:** Geometrical Content in Apasthamba Sulba Sutra

| Patal (Chapters) | Khanda (Sections) | Description on |
|---|---|---|
| 1 | 1 - 3 | Information about Bhumitiya:<br>Bhumitiya denotes different Aakrities (plain figures having faces required to construct Aagni kundas) |
| 2 | 4 - 5 | Measures required to construct Garhapatya Agni, Ahavaniya Agni and Dakshinagni and distances between them for placement. |
| 3 | 6 - 10 | Construction manuals of bricks for Garhapatya Agni |
| 4 | 11 - 14 | Shape and construction measure of Shyn citi and Agni Citi with area |
| 5 | 15 - 21 | Measures of Square shaped Shyn citi and description of bricks to construct it |
| 6 | 12 - 14 | Measure to construct Drowna Citi,Ratha Chakra Citi, Shyn citi and methods to construct bricks |
| 7 | 15 - 20 | Described the two types of Shynciti in birds shape and its construction manuals. |
| | 21 | Description of Kanka Citi and Aajal citi and Asmavedia citi in brief. |

***Source***: [Kulakarni,2003]

**Table 6:** *Geometrical Content in Kathyan SulbaSutra*

| Kandika (Sections) | Description on Sutras |
|---|---|
| 1 | Descriptions to find directions using Shanku or Sunlight. Description of Bhaumitik words like square, rectangle, triangle. Measure to construct Garhapatya Agni, Ahavaniya Agni and Dakshinagni |
| 2 | Measures to construct different types of Vedi. Construct a square having one third of given square. |
| 3 | Construct a square equal in area to the sum of two squares of different area and difference of two squares of different squares. |
| 4 | Construction manuals and required Bhumiti for Rathachhakra (Kamya) Citi. |
| 5 | Construction of square having 7.5 square purusha. |

***Source***: [Kulakarni,2003]

Before the existence of Bhaumitiya parikalpamas the different practices of geometrical constructions related to area, volume could have made to construct different Agnikundas in desired shape in equal area. To maintaine the area equal in different shaped geometrical figure there most have much experimentations through constructions and observations based on areas. Now questions like; whether there was use of any formulas related to calculate areas of geometrical figures or mentioned on the different Sulba Sutras? The following tables shows the different sutras to find areas mentioned in different Sulba Sutras.

**Table 6:** Sutras to finds areas

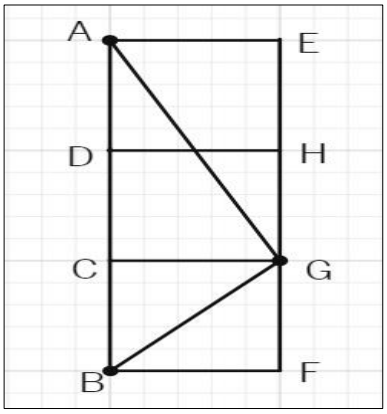
| S. N | Figure | Formula to find area | Reference |
|---|---|---|---|
| 1 | Square or rectangle | Product of length and breadth | MSS- 10.2.5.5,10.3.2.11 |
| 2 | Right angle triangle | Half the product of lambarup sides. (perpendicular) | MSS- 10.3.2.12 |
| 3 | Ghan phal (Volume) of Ghan (Cube) | Product of the Area of one face and its width | MSS- 10.3.1.6 |
| 4 | For the equal area of square and circle | A square with side length $\frac{13}{15}$ times of diameter of circle are equal in area. | BSS - 1.60, MSS - 10.3.2.13 ASS -3.6-8 KSS -3.14 |
| 5 | For the equal area of square and circle | Radius of circle = half of the side length of square $+\frac{1}{3}$ (Half of Diagonal of square – half of the side length of square) | BSS-.1.58, MSs - 10.1.1.8,10.3.2.10 ASS – 3.2 -5 KSS - 3.13 |

*Source*: [KulKarni. 2000 [9] Pp, xxviii – x xxxv.]

The table shows that there was the use of formula to find the area of square of circle, square, rectangle and right-angled triangle. Now question comes like: what is the main principle of the construction of this geometrical figure? The answers of these questions can be found from the following discussions.

**The Geometrical operations use to perform Nitya/indispensable/obligatory Alters**

In Vedic ritual there are three Agnis to be place in a Vedi; Garhapatya Agni is in the shape of square, Ahavaniya Agni in circular shape and that of the Daksina in semi – circular form. The area of each Agni must be the equal. In this placement there comes two different distances give the value of $\sqrt{5}$ and $\sqrt{2}$.

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Here, in the figure alongside, ADHE, DCGH and CBFG are three-unit squares. Point A for placing Ahavaniya Agni**,** B placing for Garhapatya Agni and G for placing Daksina Agni. AG and BG are the diagonals of rectangle ACGE and square CBFG. This figure clearly shows that BG = $\sqrt{2}$ and AG = $\sqrt{5}$. Vedic people used to draw a straight-line AB and three squares on this line with equal length. By placing the bamboo pegs between the points BG and AG they fixed the points for Agnikundas.

On this figure using Bhoja- Koti - Karna - Nayana Sutra, we get, $(AG)^2 = (AC)^2 + (CG)^2$

$= (2CD)^2 + (CG)^2$ [ because AC = 2CD]

$= 4(CD)^2 + (CD)^2$

$= 5(CD)^2$

Therefore, the diagonal AG = $\sqrt{5}$.CD

Similarly, the diagonal GD of the square CDEG will be$(GD)^2 = (CD)^2 + (CG)^2$

$= 2(CD)^2$

GD = $\sqrt{2}$ CD [Khadlilkar;1974, p.77] [7]

Thus, the length of the side of the square in the above case is known as the value of $\sqrt{5}$ and $\sqrt{2}$ used in practice on Vedic ritual geometry.

The Suba theorem of Vedic geometry is related to right angle triangle, constructions like perpendicular bisector, isosceles trapezium and circle equal in area to square. Geometric topics of the modern schools is based on majorly points, line, angles and pane. The modern school geometry has the topic based on coordinate axis, perpendicular, properties of parallelograms like; square, rectangles, circle and semicircle, isometric transformations and similarity. Telescoping the geometrical content from Vedic geometry to modern school geometry we find the commonalities between them. This shows that there is inter relationship of Vedic ritual geometry to the school geometry. But why the interrelations are not shown by the scholars? Do School geometry come into existence ignoring the mathematics of culture? Or here is belief on the school mathematics only? Teaching is defined as a set of events, outside the learners which are designed to support internal process of learning (Sequeira, 2012). Ambrose, *et al*., (2010) writes that learning is not only nurturing the mind with theoretical knowledge. It is considered as a process through which a learner attains both theoretical and practical knowledge that can help him/her in his/her life. It is also defined as a process that leads to change, which occurs as a result of experience and increases the potential of improved performance and future learning. This mirrors that there exist mathematical activities in cultural activities as well as the activities are transferred to the generations with hands – on learning method. The use of mathematical activities of a culture gives their identity as well suffices that mathematics is non – colonized ideas.

According to Obanya (2005) teachers and students bring all their cultural beliefs and practices with them with, which affects their teaching practices. Obanya beliefs on the

influence of outside events and individual differences on learning so teachers use a range of pedagogies, monitor progress and providing feedback to the students on their teaching. They, encourage student responsibility, master the content, provide a safe environment and create positive relationships. Now question can be raised like; does learning occur by nurturing the mind of the students by the teacher only? Does learning is shaped theoretical framework on the school or there is effect of practical knowledge perceived from the cultural practices of the learner? All this is possible with connecting the cultural values, shared principles of cultural activities to mathematics learning at the school.

## Conclusions

This discussion shows that the main principle of Vedic ritual geometry revolves around the precise construction of altars (Agnikundas) and other sacred spaces using geometric techniques from the period of Bharmanas (before 3068 B.C). These geometrical constructions are based on the belief that correct spatial configurations, proportions, and measurements ensures the success of rituals. Vedic geometrical activities involved proportionality and symmetry in constructing ritual altars. Proportions like the ratio of the sides of squares, the diagonals, and the areas of shapes are meticulously calculated. The ability to transform one geometric shape into another with the same area is crucial. For example, transforming a square into a circle with an equal area is often seen in Vedic rituals. The Sulba Theorem of Sulba Sutras contain an early form of the Pythagorean theorem. This theorem is used extensively to ensure that right-angled constructions are accurate, particularly for building fire altars of specific shapes, such as squares, rectangles, or isosceles trapeziums.

These topics of Vedic ritual geometry are the common to the topic of school geometry. The application of Vedic geometry in school geometry can enhance students' engagement, deepen their understanding of geometric concepts, and connect mathematical learning with historical, cultural, and practical contexts. It fosters a more inclusive, hands-on, and culturally responsive approach to learning geometry, blending ancient knowledge with modern educational practices.

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