THE EQUALIZATION OF CERTAIN RECTANGLES OF SQUARE INTO ITS CIRCLE IN AREA

R.D. Sarva Jagannadha Reddy*
19-42-S7-374, STV Nagar, Tirupati-517501, INDIA.

ABSTRACT
Circle-square composite construction is very common geometrical entity. The area of the square is very easy to arrive at with the formula $a^2$. But, it was very difficult till March 1998 to find the area of the circle of an inscribed circle in a square. By the grace of God, in this paper, an impossible concept i.e. finding the area of inscribed circle, is done very easily now from the circle’s superscribed square.

KEYWORDS— Circle, circumference, diameter, diagonal, radius, rectangle, side, square.

INTRODUCTION (BAYESIAN TECHNIQUE)
The square is a tetragon having four equal sides. A square can be divided into many rectangles. The area of each rectangle can be calculated. It is very common. In this paper, however, each constituent rectangle of a square is equated to $\pi$. The constant $\pi$ is nothing to do with the square. This was the opinion of every mathematician till March 1998.

This author, a Zoology teacher cum student, after the discovery of the real $\pi$ value, equal to $3.14644660941…$ is able to equate the constituent rectangles of a square, into $\pi$ constant, exactly. It is a well known fact, that the area of the circle is equal to $\frac{\pi d^2}{4}$, where ‘d’ is the diameter. When the diameter is one, the area of that circle becomes equal to $\frac{\pi}{4}$. The side of the circumscribed square is also equal to one, like the diameter, and hence, the area of this square, is equal to one.

In this paper, we find, the square is divided into 9 rectangles and are equated in terms of $\pi$. It is a new approach. This way the areas of its inscribed circle equal to $\frac{\pi}{4}$ is obtained in terms of the areas of rectangles and $\pi$ value, thus derived, from those rectangles, give $\pi$ value as $\frac{14 - \sqrt{2}}{4}$, and surprisingly, not the 2000-year old 3.14159265358….

Procedure:
1. **Square**: ABCD, Side = $a$ = diameter = $d$
2. Diagonals: $AC = BD = \sqrt{2}a = \sqrt{2}d$
3. Parallel side to side $DC = FK = a = d$
4. **Circle**: Centre = 0, Radius = $OG = OJ = \frac{a}{2} = \frac{d}{2}$
5. **Triangle**: GOJ, GJ = Hypotenuse = $OG \times \sqrt{2}$

= \frac{a}{2} \times \sqrt{2} = \frac{\sqrt{2}a}{2} = \frac{\sqrt{2}d}{2}

6. FG = DF = JK = KC = \frac{\text{side} - \text{hypotenuse}}{2}

= \left( a - \frac{\sqrt{2}a}{2}\right) \frac{1}{2} = \left( \frac{2 - \sqrt{2}}{4}\right) a

7. So, CK = \left( \frac{2 - \sqrt{2}}{4}\right) a

8. KB = Side BC - CK = a - \left( \frac{2 - \sqrt{2}}{4}\right) a = \left( \frac{2 + \sqrt{2}}{4}\right) a

9. So, KB = \left( \frac{2 + \sqrt{2}}{4}\right) a

10. Bisect KB into KR and RB

= \left( \frac{2 + \sqrt{2}}{4}\right) a \rightarrow \left( \frac{2 + \sqrt{2}}{8}\right) a + \left( \frac{2 + \sqrt{2}}{8}\right) a

11. Side = AB; Mid point of AB is S

12. AS = SB = \frac{a}{2}, \quad \text{Mid point of SB is U}

13. SU = UB = \frac{a}{4}

14. Bisect SU and UB into ST, TU, UV and VB
15. Side AB = a, so

16. ST = TU = UV = VB = \( \frac{a}{8} \)

17. ES = Side = a, where E and S are the mid points of DC side and AB Side.

18. H and M are also the mid points of FK side and LR side.

19. ABCD square is divided into two types of rectangles. They are

20. 1. Two middle sized rectangles DFHE and EHKC

2. Four larger rectangles FLMH, HMRK, LASM and MSBR

21. Further, the larger rectangle MSBR is divided into four equal smaller rectangles. They are MSTN, NTUP, PUVQ and QVBR

22. So, the entire square ABCD, finally consists of three types of rectangles

    Smaller rectangles = 4

    Middle rectangles = 2

    Larger rectangles = 3

    = 9

23. Areas of rectangles

    Four smaller rectangles, each side = ST = \( \frac{a}{8} \), SM = \( \left( \frac{2 + \sqrt{2}}{8} \right) a \)

    Area = ST x SM = \( \frac{a}{8} \times \left( \frac{2 + \sqrt{2}}{8} \right) a = \left( \frac{2 + \sqrt{2}}{64} \right) a^2 \)

    Three larger rectangles

    Area = LA x AS = \( \left( \frac{2 + \sqrt{2}}{8} \right) a \times \frac{a}{2} = \left( \frac{2 + \sqrt{2}}{16} \right) a^2 \)

    Two middle sized rectangles

    Area = DF x FH = \( \left( \frac{2 - \sqrt{2}}{4} \right) a \times \frac{a}{2} = \left( \frac{2 - \sqrt{2}}{8} \right) a^2 \)

24. The sum of the areas of 9 rectangles must be equal to the area of the square ABCD = \( a^2 \).

    Four smaller rectangles = 4 \( \left( \frac{2 + \sqrt{2}}{64} \right) a^2 = \left( \frac{2 + \sqrt{2}}{16} \right) a^2 \)

    Three larger rectangles = 3 \( \left( \frac{2 + \sqrt{2}}{16} \right) a^2 = \left( \frac{6 + 3\sqrt{2}}{16} \right) a^2 \)

    Two middle rectangles = 2 \( \left( \frac{2 - \sqrt{2}}{8} \right) a^2 = \left( \frac{2 - \sqrt{2}}{4} \right) a^2 \)

    = \( \frac{2 + \sqrt{2}}{16} \) a^2 + \( \frac{6 + 3\sqrt{2}}{16} \) a^2 + \( \frac{2 - \sqrt{2}}{4} \) a^2 = \( a^2 \)
PART-II RECTANGLE AREAS ARE EQUATED TO $\pi$

In the above Part I, the arithmetical values of rectangles are arrived at. Now, the above same areas of rectangles are equated to $\pi$ constant.

25. Each rectangle is equated in terms $\pi$

Each smaller rectangle = \[ \left( 2 + \frac{\sqrt{2}}{64} \right) a^2 = \left( \frac{4 - \pi}{16} \right) a^2 \]

Each middle rectangle = \[ \left( 2 - \frac{\sqrt{2}}{8} \right) a^2 = \left( \frac{\pi - 3}{2} \right) a^2 \]

Each larger rectangle = \[ \left( 2 + \frac{\sqrt{2}}{16} \right) a^2 = \left( \frac{4 - \pi}{4} \right) a^2 \]

26. Area of the ABCD square (in terms of $\pi$)

= \[ 4 \left( \frac{4 - \pi}{16} \right) a^2 + 2 \left( \frac{\pi - 3}{2} \right) a^2 + 3 \left( \frac{4 - \pi}{4} \right) a^2 \]

= \[ \left( \frac{4 - \pi}{4} \right) a^2 + (\pi - 3) a^2 + \left( \frac{12 - 3\pi}{4} \right) a^2 = a^2 \]

27. With the guidance of the known new $\pi$ value of March 1998, the following rectangles constitute the area of the inscribed circle and the remaining as the four corner areas in between circle and square.

2. Middle sized rectangles = \[ 2 \left( \frac{2 - \sqrt{2}}{8} \right) a^2 = 2 \left( \frac{\pi - 3}{2} \right) a^2 \]

+ (plus)

3. Larger rectangles

= \[ 3 \left( \frac{2 + \sqrt{2}}{16} \right) a^2 = 3 \left( \frac{4 - \pi}{4} \right) a^2 \]

= \[ \left( \frac{2 - \sqrt{2}}{4} \right) a^2 = (\pi - 3) a^2 \]

= \[ \left( \frac{6 + 3\sqrt{2}}{16} \right) a^2 = \left( \frac{12 - 3\pi}{4} \right) a^2 \]

The sum of these areas of rectangles, is equal to, the area of the circle

= \[ \frac{\pi d^2}{4} = \frac{\pi a^2}{4} \]

= \[ \left( \frac{2 - \sqrt{2}}{4} \right) a^2 + \left( \frac{6 + 3\sqrt{2}}{16} \right) a^2 = (\pi - 3) a^2 + \left( \frac{12 - 3\pi}{4} \right) a^2 \]
22
8 4 2 6 3 2 4 12 12 3 aa 16 4
\[\begin{align*}
&= \left(\frac{8 - 4\sqrt{2}}{16} + \frac{6 + 3\sqrt{2}}{16}\right) a^2 = \left(\frac{4\pi - 12 + 12 - 3\pi}{4}\right) a^2 \\
&= \frac{14 - \sqrt{2}}{16} a^2 = \frac{\pi a^2}{4} \\
\therefore \pi &= \frac{14 - \sqrt{2}}{4}
\end{align*}\]

28. Four smaller rectangles of larger rectangle MSBR, and each smaller rectangle of this larger rectangle represents each corner curvilinear area of the square, which is outside the inscribed circle, on four corners of the ABCD square.

CONCLUSION
The circle-square composite construction is represented as the sum of 9 rectangles, demarcating exactly, the area of the circle and the four corner areas of the square, outside the inscribed circle.

DISCUSSION
Pi value is derived geometrically by the Exhaustion method of Eudoxus of Cnidos (408-355 B.C.). Using the same method Archimedes of Syracuse (240 B.C.) said π value is less than 22/7. Later mathematicians finalized π value as 3.14159265358... geometrically, by refining the same Exhaustion method of Eudoxus. From 1450 AD onwards, infinite series came which was introduced by Madhava of Kerala, India. Thus from Madhava, and independently by John Wallis (1660) of England and James Gregory (1660) of Scotland till today, with the infinite series of Simon Plouffe (1996), 3.14159265358... of Exhaustion method has been established as final value to π constant.

Paragraph 2. Thus, from the past to the present, this number: 3.14159265358... has ruled the mathematical world as Pi of the circle. The same value has been derived by Sir Isaac Newton, Leonhard Euler, S.Ramanujan and about a dozen great mathematicians. It has been called a transcendental number by C.L.F. Lindemann. 3.14159265358... has been dissociated from the circle altogether from 1660. However, it was argued, squaring a circle an unsolved geometrical problem. It is confusing that π number has been dissociated from the circle, on one hand, and the impossibility of squaring a circle with 3.14159265358... has been said again, on the other, going back to the square a circle.

3. Secondly, in the Exhaustion method, the so called π number 3.14159265358... is derived from the regular polygon, involving $\sqrt{3}$ . The same number 3.14159265358... is computed from the infinite series without using square root extraction.

4. Geometrically, square root extraction is a must in getting 3.14159265358... and in the infinite series, the operation of square root extraction is vehemently opposed, and hence, this number 3.14159265358... called a special and non rational number as a transcendental number.

5. Thus, the number that was derived from regular polygon and from infinite series, though, is same, it is called differently. An algebraic number 3.14159265358 of regular polygon with $\sqrt{3}$ derivation, has been elevated to the status of a transcendental number, when it is derived from infinite series without square root extraction. Again here, we find contradictory statements.

6. Third ambiguity regarding 3.14159265358... is, it represents polygon

\[\frac{\text{Perimeter of polygon}}{\text{Diameter of circle}} = \pi\]

The original definition of π is
Circumference of circle
\[ \frac{\text{Diameter of the same circle}}{= \pi} \]

Here also, we find 3.14159265358… which is derived from the polygon-circle hybrid combination. Hence, 3.14159265358… is not a pure \( \pi \) value, in other words, it is a hybrid \( \pi \) value.

7. Calling 3.14159265358… as a transcendental number by C.L.F. Lindemann is cent per cent correct. However, this number is not \( \pi \) of the circle.

8. C.L.F. Lindemann is wrong, if he calls \( \pi \) constant a transcendental number. Why?

9. His proof was based on Euler’s equation \( e^{i\pi} + 1 = 0 \).

This equation accepts \( \pi \) radians 180\(^0\). But, Euler’s equation rejects \( \pi \) constant 3.14.

\[ e^{\sqrt{-1} \cdot 180} + 1 = 0 \quad \text{Right} \]
\[ e^{\sqrt{-1} \cdot 3.14} + 1 = ? \quad \text{Right or Wrong?} \]

How can Lindemann incorporate \( \pi \) radians 180\(^0\) in the Euler’s equation and give transcendental status to another one i.e. \( \pi \) constant 3.14 ? Is it not a wrong conclusion? His conclusion may be right when \( \pi \) radians 180\(^0\) = \( \pi \) constant 3.14

**Does mathematics accept the above equation?**

Euler’s equation accepts \( \pi \) radians 180\(^0\) only. Does this number 180 deserve a transcendental status then? Thus, this is another one which has conditioned the thinking of mathematicians since 1882, unfortunately.

10. **Yet another confusing** observation is, till March 1998, nobody knew the real \( \pi \) value. Without knowing the true \( \pi \) value, how can one say that squaring of circle is an unsolved geometrical problem? The number 3.14159265358… which actually represents polygon and expecting this transcendental number of “circle”, and converting it into a square (squaring a circle) is another human created problem which does not exist in geometry.

11. Thus, everything done, so far, for 2500 years, has been attributed to circle, its value and nature of \( \pi \) – and are all questionable statements, except the work of Hippocrates of Chios (450 B.C) who squared lunes, squared full circle and also squared semi-circle with the help of lunes. His work alone is cent percent perfect and excellent. It must have disturbed the real thinkers of mathematics, in the past 2500 years.

12. The Nature, must have dissatisfied with the prevailing wrong notions on \( \pi \), and would have perhaps, thus chosen a non-mathematician in this author, and revealed to him the real \( \pi \) value \( \frac{14 - \sqrt{2}}{4} \) an algebraic number to tell the world, after keeping this author 26 long years (from 1972 to March 1998) in pensive mood or in gestation period for inculcating in him, to develop patience and prepared him for not to get disturbed when the onslaught on his work and on him personally, would be very extreme and filthy sometimes, due to the intolerance of a few people across the world, as this new value is radical or revolutionary in nature and oppose the whole mathematical world, coming from a layman in mathematics, a Zoology teacher cum student.

13. Everything said about \( \frac{14 - \sqrt{2}}{4} \) has been questioned and rejected. Every method which derives \( \frac{14 - \sqrt{2}}{4} \) has been questioned that this method does not agree with any known geometrical concepts. Association of circle with \( \sqrt{2} \), circle with square, rectangle, triangle, trapezium has been objected.
14. Hence, this author is not disturbed and distracted with the indecent comments made on his work and on him personally, by some, but hopes on the Mathematical establishment. It is also said, all the 100+ methods have been passing on undetectably a mistake to the next every method. To sum up, this author is not against the number 3.14159265358… (of polygon). Attribution of this number to circle as its circumference is wrong. This arrangement is only a stop-gap (= temporary substitute) in character, till the real \( \pi \) value is known. Now, the true value is known. Thank God, Sirs! Decision is Yours.

This paper is humbly dedicated to HIPPOCRATES OF CHIOS for he alone understood the circle, rightly. He was honoured already as the Founding Father of Mathematics for he authored the first book on Mathematics which became the guidance for Euclid’s Elements. Hippocrates of Chios should be honoured with 1\textsuperscript{st} Greatest Mathematician instead of OR in addition to the Founding Father of Mathematics (Now, the real \( \pi \) value 3.14644660941… is known and from this, Archimedes’s prophesy of value of \( \pi \) equal to less than 22/7 = 3.142857142857… proved false).

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