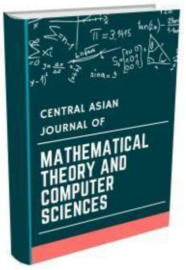

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Article

Improving the Methods for Determining the Basic Dimensions of the Egyptian Triangle

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Abstract: The article is devoted to the ordinal number of the Egyptian triangle, its place and importance in the mathematical calculations performed to find the sizes of these triangles, as well as several new formulas used to present these mathematical calculations and their application are given in this work. In fact, a table of the Egyptian triangle's order is given and it is possible to find the quantitative dependences of the components found by the formulas proposed for the mathematical calculations.

Keywords: Improving, Methods, Determining, Basic Dimensions, Egyptian Triangle

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1. Introduction

According to the criteria of current development, it should be paid special attention to the teaching of mathematics and its elements in the process of training engineers-teachers. The right angle and its properties have been consistently used in building geometry since ancient times in solving topical problems in the field of design, construction and operation of engineering communication systems. For example, this was clearly reflected in the construction of the Egyptian pyramids in ancient world construction engineering in history [1].

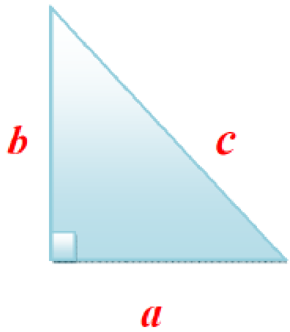
The Greek philosopher and prominent figure in the field of construction, Pythagoras, also mastered the practices of ancient Egyptian civil engineering and compiled a table showing the quantitative interdependence of the famous right-angled triangles, known as his "Pythagorean triangles". This table served as a key factor in the formation of the Pythagorean theorem, which is still used today [2].

However, no table has been drawn up showing the quantitative dependence of the Egyptian triangles to date, and no formulas have been given that can directly reflect the criteria. In this work, we present the results of our research about this area in recent years. The level of study of the Egyptian triangle to date confirms that the basic dimensions and associated properties are not completely researched.The Egyptian triangle is still being analyzed using traditional solutions. Relating to this triangle, the quantities, properties, and calculation formulas recommended in this article have not been implemented yet.Undoubtedly, positive results will be achieved through their implementation and application. As the author of this article and research, I propose introducing formulas regarding the Egyptian triangle and dimensions that have never been used anywhere [3].

2.The Basic Concepts of the Egyptian Triangle

The type of triangle, called the Egyptian triangle, is a right-angled triangle with sides 3, 4 and 5 respectively.Cathetuses are a = 3, b = 4, and the hypotenuse is c = 5. The sizes of the remaining triangles will consist of multiplication of these numbers. For example; The sizes of the third order are 9, 12, 15, respectively. Here the sides are multiplied by 3.

Therefore, the sequence number of this triangle is n = 3.



Description: All right-angled triangles with sides 3, 4, 5 are called Egyptian triangles.

The main idea underlying the Pythagorean theorem is that "the square of the hypotenuse is equal to the sum of the squares of the cathetuses" of the Egyptian triangle. In any order, the cathetuses and hypotenuse in the Egyptian triangle will be able to see that this rule is absolutely true[4]. Let's write this famous rule:

$$a^2 + b^2 = c^2, (1)$$

This rule is quite true between cathet uses and hypotenuse of the Egyptian triangle in any order.For example: ifn =7 is a = 21, b = 28, c =35, 212 + 282= 352 , that is 441+784 = 1225the same rule applies to triangles of any order.The root is used to find the value of either side:

$$c = \sqrt{a^2 + b^2}, (2)$$
$$a = \sqrt{c^2 - b^2}, (3)$$
$$b = \sqrt{c^2 - a^2}, (4)$$

Our main goal is to delve given idea deeper. This is a new theory that the main thing is to introduce the concept of the number of the Egyptian triangle, which has never been used before. Secondly, we want to justify our suggestions and recommendations on how to optimally calculate all sizes of the Egyptian triangle [5].

These concepts require the following interdisciplinary study of creative research. It is:

1. Between the sides and numbers of the Egyptian triangle;

2. Between the sides, ordinal numbers and perimeter;

3. Between the side, ordinal numbers and surface;

4. Development of new relationships between the number, perimeter and surface, as well as making proposals for the educational system and practice in general, giving its description of teaching and research methods.Since the sizes of all sides of these triangles are multiple, they are interconnected by known rules. These values are reflected in the table below.

Egyptian Triangle
Table 1.

n	*a*	*B*	c	s_Δ	p_Δ
1	3	4	5	6	12
2	6	8	10	24	24
3	9	12	15	54	36
4	12	16	20	96	48
5	15	20	25	150	60
6	18	24	30	216	72
7	21	28	35	294	84
8	24	32	40	384	96
9	27	36	45	486	108
10	30	40	50	600	120
15	45	60	75	1350	180
20	60	80	100	2400	240

2. Materials and Methods

The study applies quantitative techniques through Egyptian triangles where each successive segment maintains 3-4-5 proportions but increases its size by natural numbers. The method produces mathematical expressions to determine such measurements as triangle sides (catheti and hypotenuse) and perimeter and surface area through their ordinal number alone. The development starts with defining proportional side-length relationships with serial number values after which the methodology establishes explicit formulae for triangle perimeter ($P\Delta = 12 \cdot n$) along with area ($s\Delta = 6 \cdot n^2$). Through analytical steps and proportional logic together with algebraic transformations the research constructs an analytical framework for calculating triangle attributes independently from conventional procedures. The formula verification process uses worked examples where values of n are applied to confirm accuracy levels. The method uses step-by-step teaching while also being systematic thus enabling useful applications in educational and engineering practices. Researcher Aharon Minz views ordinal calculation methods as a breakthrough because they maximize triangular parameter determinations while advancing comprehension of Egyptian geometry.

3. Results and discussion

3.The Main Properties

Property 1: The number multiplied by the sides of the Egyptian triangle is its serial number.

For example: the sides of the triangle with the number n = 9are equal to the numbers 3,4,5 multiplied by 9, that is$a = 3 \cdot 9 = 27$, $b = 4 \cdot 9 = 36$, $c = 5 \cdot 9 = 45$.The results are listed in the table below.

N	*a*	*b*	*c*
9	27	36	45

Property 2:The surface size of the 2nd Egyptian triangle is equal to the size of the perimeter.

That is, $s\Delta = P\Delta = 24$

Property 3: Lowered to side b of the Egyptian triangle

h_b–height is equal to side a, lowered to side a, h_a–height is equal to side b.

$b = h_a$, (6)

Feature 4: Lowered to side c of the Egyptian triangle

h_c – height, is constant size which is equal to multiplication of a and b sides that is divided by c

Explanation: h_c– the value of the height, is always equal to 2,4·n:

$h_c = ab / c$, (7)

$h_c = 2{,}4 \cdot n$, (8)

4.Formulas and Methods of Calculating the Perimeter and the Surface of the Egyptian Triangle

When calculating the perimeter, we obtain the sum of all sides and when calculating the surfacewe obtain the half of the multiplication of the cathetuses. These are common rules that are known in advance and it is the traditional way of calculating it.

The method is written as follows:

$P\Delta = a + b + c$,(9)

$$S_\Delta = \frac{ab}{2}, (10)$$

These formulas are common for calculating the triangular surface and the perimeter, and also allow calculating the surface and perimeter of the Egyptian triangle. Here:

$P\Delta$-perimeter of triangle,

$s\Delta$- surface of triangle.

The calculation of the perimeter and surface of the Egyptian triangle can be done by formulas common to triangles.

The method I recommend is to find the Egyptian triangle perimeter and surface in any order easily by the size of the Egyptian triangle perimeter and surface. The formulas created for these calculations are as follows:

$P\Delta n = n \cdot P\Delta 1$, (11)

$$s_{\Delta n} = n^2 \cdot s_{\Delta 1}, (12)$$

5. Methods for Calculating the Cathetuses, Hypotenuse, Perimeter and Surface of the Egyptian Triangle by its Serial Number

All the magnitudes of the Egyptian triangle can be calculated by its serial number, ie the multiplication. The cathetuses and hypotenuse of any order of the Egyptian triangle are calculated by the following formulas:

$$a_n = n \cdot a_1, (13)$$
$$b_n = n \cdot b_1, (14)$$
$$c_n = n \cdot c_1, (15)$$

The perimeter of the Egyptian triangle is calculated by using its serial number in this formula:

$P\Delta n = 12 \cdot n$, (16)

The surface of the Egyptian triangle is calculated by using its serial number in the following formula:

$$s_{\Delta n} = 6 \cdot n^2, (17)$$

6.Methods of Calculating the Surface by the Perimeter and the Calculation of the Perimeter by the Surface

We will try to determine the relation between the perimeter and the surface of the Egyptian triangle by taking the formula (16) and (17).

Here we obtain the ratio as (8) / (7):

$$\frac{S_{\Delta_n}}{P_{\Delta_n}} = \frac{6n^2}{12n} = \frac{n}{2}, (18)$$

This equation (18), that is, the proportions, allows us to find the formula for the interrelationships of P_{Δ_n} and S_{Δ_n}:

$$P_{\Delta_n} = \frac{2}{n} \cdot S_{\Delta_n}, (19)$$

$$S_{\Delta_n} = \frac{n}{2} \cdot P_{\Delta_n}, (20)$$

If we take into account equations (11) and (12), then we can write formulas (19) and (20) through P_{Δ_1} and S_{Δ_1} as follows:

$$P_{\Delta_n} = 2 \cdot n \cdot S_{\Delta_1}, (21)$$

$$S_{\Delta_n} = \frac{n^2}{2} \cdot P_{\Delta_1}, \qquad (20)$$

Studying this method is easily accomplished by remembering the triangular sizes of the first order. (3, 4, 5, 6, 12).

7. Samples of Calculating Some Exercises:

Sample I.

We will show that you calculate 3 of Exercise 1. According to the condition of the exercise c n = 10, it is asked to find the serial number here. For this, we use the formula (6), that is,

c n = n · c1, (6)

It means; subject to the following conditions:

10 = n · 5

n = 2

The answer is 2.

I look forward to your valuable advice on this method and article.

Sincerely Author

4. Conclusion

This article gives the optimal ways to calculate the sizes of these triangles, which are preferred over traditional calculation methods, by the ordinal number of the proposed Egyptian triangle, and demonstrates by means of these new progressive methods that it is easy to perform calculations.

A detailed analysis was made of the calculation paths of the sides of the Egyptian triangle, which can be cross-linked by the surface and perimeter, followed by the sequence number [6].

In calculating the sizes of the Egyptian triangle, it was explained by introducing the recommendations given for the practical implementation of the formulas proposed for application, by solving problems in the field [7-8].

The proposed calculation formulas have been shown to be far superior to the traditional methods available to date in finding solutions to the problems of the Egyptian triangle, by overcoming real problems.

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