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# Cylinder Geometry Modeling in Some Macro and Microstructures in Nature

Ali Özdemir

*Mathematics / Faculty of Engıneering and Natural Sciences, Manisa Celal Bayar University, Türkiye*

*(acaozdemir@gmail.com)*

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***Abstract –*** Our study has shown that the micro and macro morphological structures of some living tissues have different geometric models, and that these microstructures can be defined numerically and shown with formulas. In the study, information on the subject in the literature was obtained in the evaluation of micro and macro structures within the geometric framework. As a result of our research, we found that the some macro and micro structures whose microscopic structures we examined with help microscopy of plants has cylinder geometric models. A cylinder (from Ancient Greek κύλινδρος (kúlindros) 'roller, tumbler') has traditionally been a three-dimensional solid, one of the most basic of curvilinear geometric shapes. In elementary geometry, it is considered a prism with a circle as its base. The geometric structures related to these geometric models, microscopic photographs showing their micro structures and the formulas of the numerical properties of these structures are given in the study. Most living materials in nature have a geometric model. The geometric shapes of these structures, their positions of coming together, the areas they cover, and their durability affect the functionality of their entirety. With this study, we tried to determine the geometric modeling of some living structures that we see around us and share our planet with. The method we applied was done by identifying geometric models or shapes that most closely resemble the actual shape of the micro and macro structures. At the same time, literature information from similar studies was also used. On the other hand, literature information about the geometric models and mathematical formulas of these micro and macro structures was evaluated. In addition, the structures of the geometric models obtained from these definitions were shown with figures. As a result, we were to detect cylinder geometric models the macro and microstructures of some plant tissues.

*Keywords – Cylinder, Geometric Modeling, Micro, Macrostructure, Mathematical Formulas.*

## I. INTRODUCTION

In nature, we can see that many living and non-living macro structures have a geometric model. However, it is impossible to observe these geometric models with the naked eye in microstructures that we can only observe with the help of a microscope. In this study, we tried to observe geometric models in some of the micro and macro structures of plants, which are living structures. As a result of our study, we observed that some of these micro and macro structures that we used as research material have a cylinder geometric model, which is defined in geometry. A cylinder (from Ancient Greek κύλινδρος (kúlindros) 'roller, tumbler') has traditionally been a three-dimensional solid, one of the most basic of curvilinear geometric shapes. In elementary geometry, it is considered a prism with a circle as its base [1].

The cylinder obtained by rotating a line segment about a fixed line that it is parallel to is a cylinder of revolution. A cylinder of revolution is a right circular cylinder. The height of a cylinder of revolution is the length of the generating line segment. The line that the segment is revolved about is called the axis of the cylinder and it passes through the centers of the two bases [2].

In the study, mathematical formulas that can be used in calculating the properties of numerical data such as volume and surface area of this cylinder geometric model that our examples have were expressed based on geometry data in the literature [1],[5],[6], [7],[8].

## II. MATERIALS AND METHOD

The micro and macro structures of tissues belonging to different plants were used for the study. To obtain the microstructures of the samples in the study, cross-sections were taken from different parts of these samples to be examined under the microscope. To examine the microstructures, the preparations prepared by staining the sections were photographed under the microscope using different magnification objectives with a Leica brand (Leica DM3000) camera light microscope. In mathematical evaluations, mathematical concepts determined in the light of literature were used to describe the geometric models of microstructures. [5],[6],[7]. In addition, the structures of the geometric models obtained from these definitions were shown with figures (Figure 1-6). It was shown that geometric properties such as surface areas and volumes could be calculated using these determined values.

## III. RESULTS

Our study has shown that the micro and macro morphological structures of some living tissues have different geometric models, and that these microstructures can be defined numerically and shown with formulas. In the study, information on the subject in the literature was obtained in the evaluation of micro and macro structures within the geometric framework. As a result of our research, we found that some macro and microstructures whose microscopic structures we examined with help microscopy of plants had cylinder geometric models. The geometric structures related to these geometric models, macro and microscopic photographs showing their micro, macro structures and the formulas of the numerical properties of these structures are given in the study (Figure 1-6).

In elementary geometry, a cylinder is considered a prism with a circle as its base. A cylinder may also be defined as an infinite curvilinear surface in various modern branches of geometry and topology (Figure 1) [8],[9].

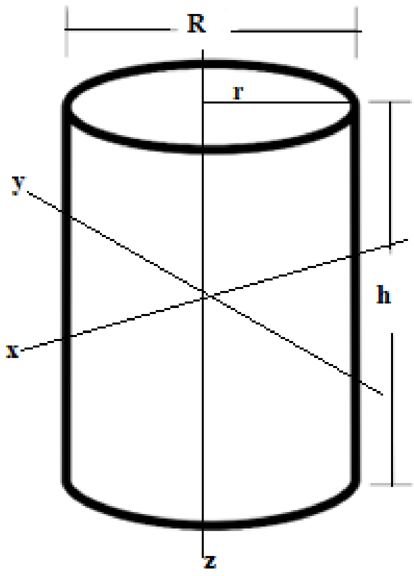


Fig. 1 A circular right cylinder of height *h* and diameter *R*=2*r* [1].

The surface area and volume formulas of the cylider geometric model are shown below

Surface area: $2\pi r\,(r + h)$

Volume: $\pi r^2 h$.

A solid bounded by a cylindrical surface and two parallel planes is called a (solid) cylinder. The line segments determined by an element of the cylindrical surface between the two parallel planes is called an element of the cylinder. All the elements of a cylinder have equal lengths. The region bounded by the cylindrical surface in either of the parallel planes is called a base of the cylinder. The two bases of a cylinder are congruent figures. If the elements of the cylinder are perpendicular to the planes containing the bases, the cylinder is a right cylinder, otherwise it is called an oblique cylinder. If the bases are disks (regions whose boundary is a circle) the cylinder is called a circular cylinder. In some elementary treatments, a cylinder always means a circular cylinder [8]. An open cylinder is a cylindrical surface without the bases.

A cylinder having a right section that is an ellipse, parabola, or hyperbola is called an elliptic cylinder, parabolic cylinder and hyperbolic cylinder, respectively [9].

**Elliptic cylinder**

If AB > 0 this is the equation of an elliptic cylinder [15].

$$\left(\frac{x}{a}\right)^2 - \frac{y^2}{b} = 1.$$

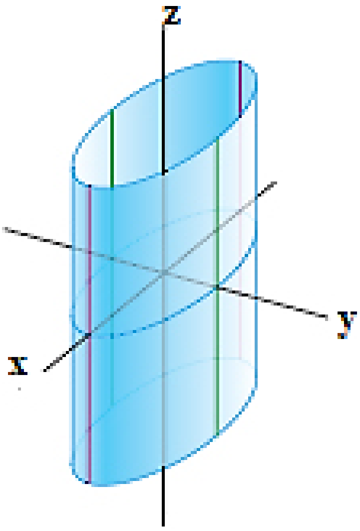

Figure 2. Geometric modeling of the elliptic cylinder [8], [9].

**Hyperbolic cylinder:**

If *A* and *B* have different signs and $\rho \neq 0$ , we obtain the *hyperbolic cylinders*, whose equations may be rewritten as:

$$\left(\frac{x}{a}\right)^2 - \frac{y^2}{b} = 1.$$

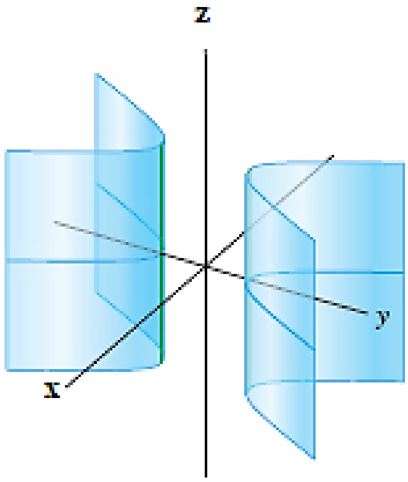

Figure 3. Geometric modeling of the hyperbolic cylinder [8], [9].

**Parabolic cylinder:**

If AB = 0 assume, without loss of generality, that B = 0 and A = 1 to obtain the parabolic cylinders with equations that can be written as:

$$x^2 + 2ay = 0 .$$

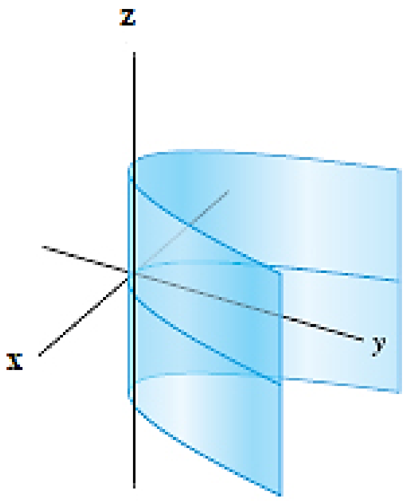


Figure 4. Geometric modeling of the parabolic cylinder [2].

Figure 5. Original macro structure photographs with cylinder geometric model

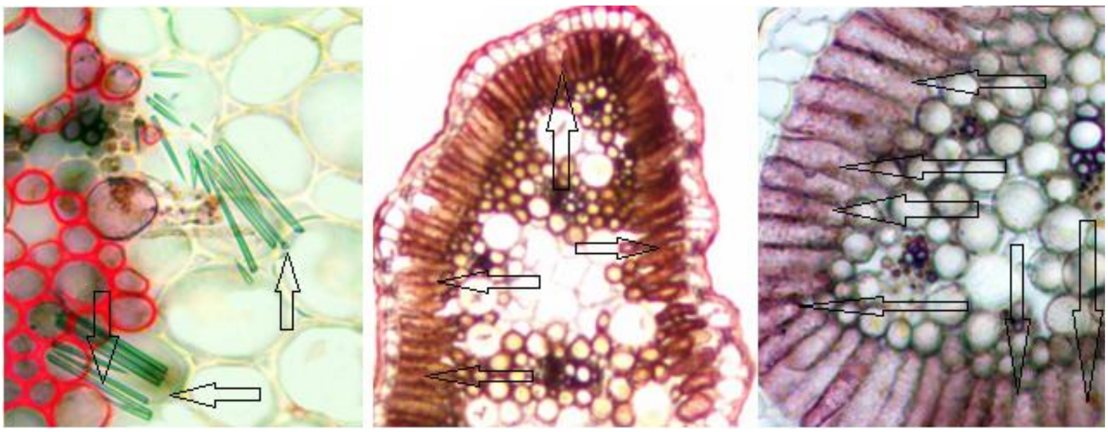

Figure 6. Original microscope images with cylinder geometric model

## IV. DISCUSSION

In this study, the geometric models the micro and macro structure of some plant samples used as material were investigated. It was observed that some micro and macro structures of the samples that constitute the subject of the study had cylinder geometric models. With this study, the geometric modelling of some micro and macro structures of plants was tried to be revealed by using the definitions corresponding to the geometrical rules. It has been seen that some micro and macro structures have properties that can be defined in geometry and expressed with parametric formulas.

All living and nonliving materials are made up of many micro and macro structure that make up their whole. The coming together of these structures are not random, they are placed in a certain order. The geometric models of these micro and macro structure are factors that affect their distribution and settlement patterns in the area where they are located.

In this study, different perspectives were provided by evaluating the structures of some micro and macro mathematically. Ultimately, the studies similar to this study creates a new comparison opportunity for future research on the relevant subject. There are similar studies in the literature on the micromorphological structures of plants having geometric models. However, similar studies on microstructures are very few in the literature [10],[11],[12],[13], [14],[15],[16],[17].

## V. CONCLUSION

In the study, it was determined that the macro and micro structures of some plants that we share the same environment have geometric models that can be defined in geometry and whose properties can be shown with formulas. Similarly, we think that knowing the geometric models of such structures in nature will provide clues about their functioning. This study has attempted to reveal the usability of some microstructures whose geometric properties have been revealed as sample models in many areas. Thus, a different perspective has been tried to be brought to the relevant field for future research on similar subjects.

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