

Working Triangles and Sections in a Regular Rectangular Pyramid

Florin Ioan Maris

Școala cu clasele I-VIII Nr.2, Lugoj, România

florin_maris@yahoo.com

ABSTRACT. The GeoGebra application will be used to view the triangles working for a regular quadrilateral pyramid, the pyramid for their move by sliding, in order to be presented as 2D imagine and view a section parallel to the base designed to any distance from the top of the pyramid.

1. Drawing a pyramid with GeoGebra

The perception of three dimension shapes is a challenge for all teacher and students. When it comes to extract particular geometric figures from a three dimension shape, then students are almost giving up.

In this section I propose using GeoGebra for giving another perception about Working Triangles and Particular Sections in a Rectangular Pyramid.

First step in constructing any Sections or Triangle within a Pyramid is to build the Pyramid itself.

I propose a position of a convenient choice, having the base of the pyramid with the vertices $A(-6, -1)$, $B(2, -1)$, $C(6, 1)$, $D(-2, 1)$, and the pyramid vertex at $V(0, 12)$. The chosen position shows a pyramid having a base edge of 8 units and a height of 12 units.

For a better image, the axes and the grid can be hid.

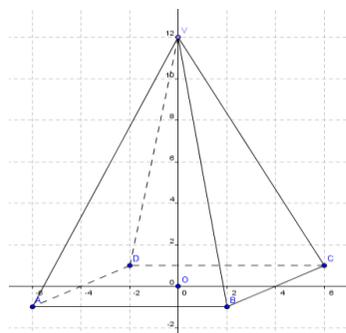


Image 1

Once we have the vertices on the graphing area, it is useful to fix the points (Image 1):

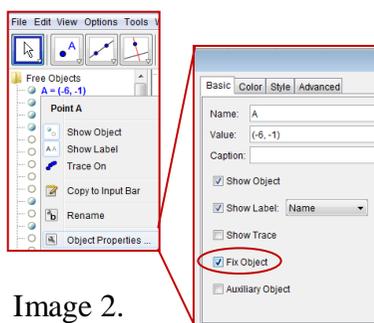


Image 2.

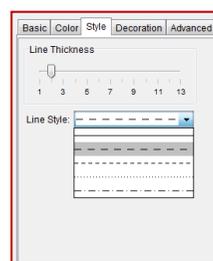


Image 3.

In that manner, the pyramid will not, accidentally, change its shape. Also, for a better comprehension of three dimension shapes, we can change the style of unseen lines to interrupted line (Image 2).

We can now proceed to show triangles and extract them from the pyramid.

2. Using sliders to extract working triangles from the pyramid

By working triangles I understand right triangles determined by important segments of the pyramid. These triangles are :

- The triangle determined by: the Height of the pyramid, the Radius of the base's circumscribed circle and the pyramid Edge ;
- The triangle determined by: the Height of the pyramid, the Base's Apothem and the Pyramid's Apothem ;
- The triangle determined by: the Pyramid's Apothem, the Pyramid's Edge and a half-base side.

To realize the sliding movement, is needed an initial position of the triangle, a final position of the triangle, or at least of its vertices, and a variable that achieve the sliding between the two positions.

a. Setting the initial triangle.

As we don't have all the vertices of these triangles drawn, we fix the point $O(0, 0)$ as the centre of the base and M as the midpoint of BC . They will allow us to build the working triangles.

Using the points A , O and V , construct the triangle AOV . Once the triangle shows up, it will get a name (poly3). The color of the triangle can be changed by right-clicking on the triangle and choosing Object properties, Color. It is useful when more than one figure will be shown in the picture.

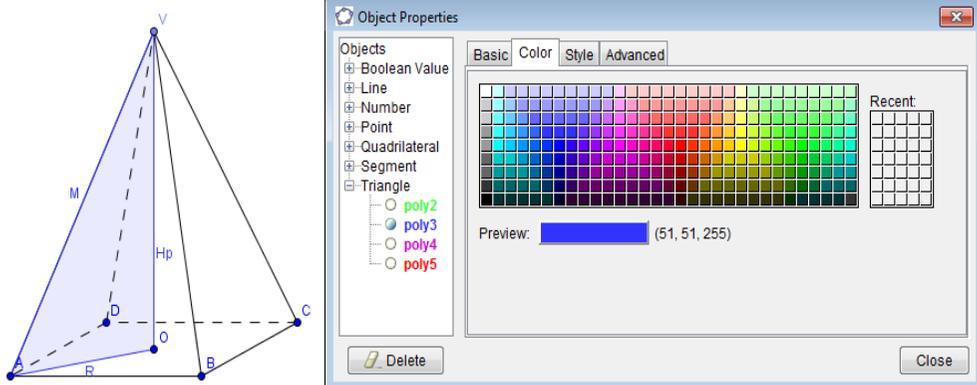


Image 4.

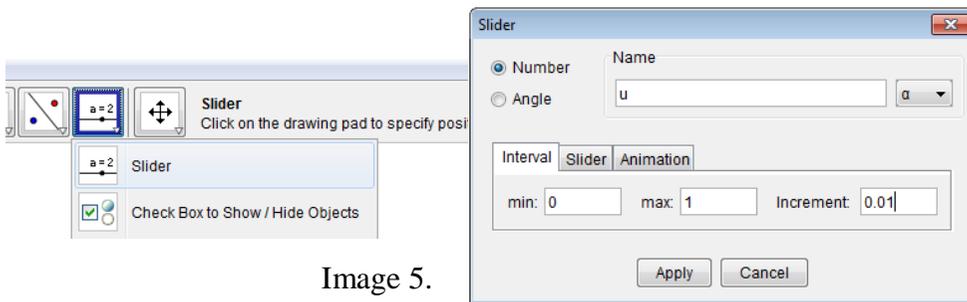
b. Setting the final position of the triangle.

The final position of the triangle AOV is set in the triangle named JLI. The coordinates assigned to the points are J (12.3 , 0) ; L(18 , 0) ; I(18 , 12) , and reflect the correct ratio between given length.

As specified earlier, the final position for the vertices will be sufficient to simulate the extraction.

c. Setting the slider

Choose Slider from the Menu bar. Clicking on the drawing pad will set the slider position, as well as opening a dialog box asking about slider's properties.



The slider is a number named n , variable between 0 and 1, with an increment of 0.01, for showing a smooth movement.

To realize the movement between the position AOV of the triangle to the position JLI, right-click above the triangle, choose Object properties, and in the Definition field, change from Polygon [A, O, V] to Polygon [J n + A (1 - n), L n + O (1 - n), I n + V (1 - n)].

Going back in the drawing pad and sliding the bullet on the sliding bar we can see the triangle AOV leaving its position and moving toward JLI position.

Proceeding in the same way, can be realized any sliding of any triangle from one position to another.

3. Representing a parallel base section

In this section we will represent a section of the pyramid by a plane parallel with its base.

GeoGebra has a feature named Check box to Show / Hide objects, that fits our needs.

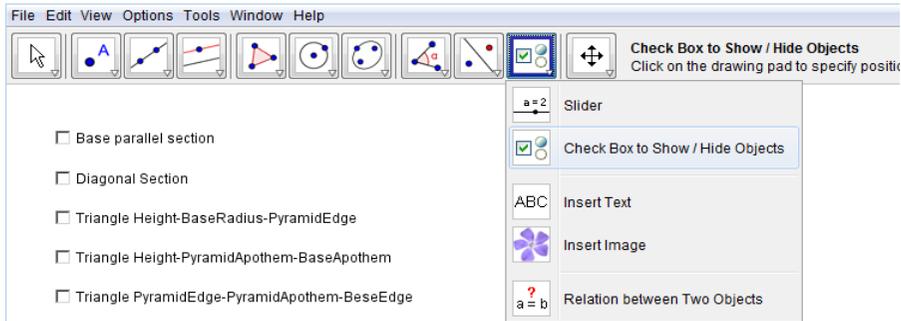


Image 9.

Choosing the button "Check box to Show / Hide Objects" will open a dialog box, that asks for the Caption name and for the object/s that will be shown / hidden by this particular Check box.

If, as said before, each section or working triangle will have a different color, it will be easy to select all parts of the same object. For example, the parts of the Diagonal Sections are displayed in green, the same color as the triangle in the pyramid. So from the list with all the objects used, select the ones that are green, being part of the same polygon.

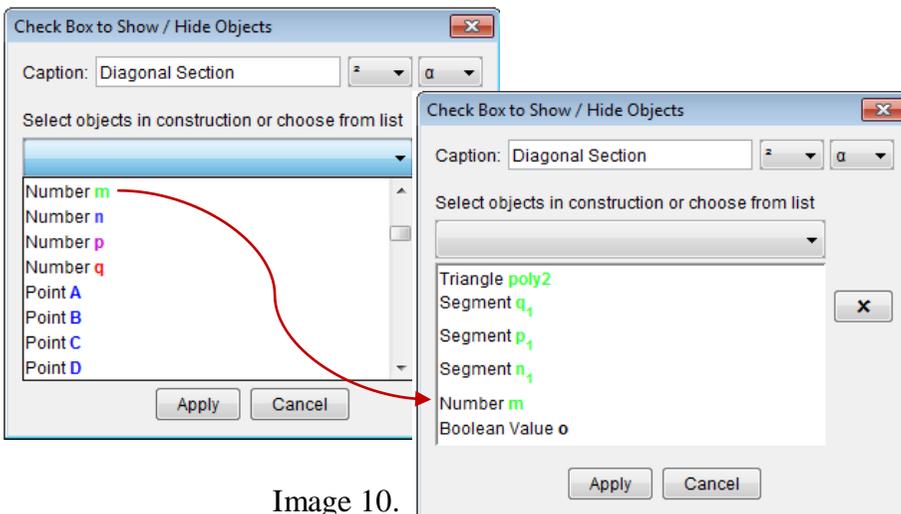


Image 10.

For each and every object we want to hide, we have to go over these steps.

Same as the vertices or the pyramid, the position of the Check box might very well be fixed. That way, the check box will always be visible on the drawing pad, letting you the choice of what you want to see or not.

Bibliography

- Dana Radu, Eugen Radu** – *Matematică Manual pentru clasa a VIII-a*, Ed. Teora, 2000
Markus Hohenwarter – *Introduction to GeoGebra*,
www.geogebra.org/book/intro-en, 2008

The logo for the GeoGebra Institute of Timișoara, România. It features a blue background with a grid and a central graphic of a blue ring with four spheres. The text "GeoGebra" is prominently displayed in a large, bold font, with "Institute of Timișoara, România" below it. In the top left corner, there is a small diagram of a circle with points and the equation $f(x) = x^2 + 3x^2 - 1x - 2$. In the top right corner, there is a circular logo of the "Căminul de Cultură și Literatură 'E. M. Petrescu' Timișoara".

$f(x) = x^2 + 3x^2 - 1x - 2$

GeoGebra

Institute of Timișoara, România

Filiala din România a Institutului Internațional GeoGebra

str. Lascăr Catargiu nr. 4 - 6, 300559 Timișoara - etajul 2

www.geogebra.org www.geogebra.tibiscus.ro