How to Determine the Major and Minor Axis of an Ellipse if Two Conjugate Diameters of it were Determined

Manh Hong Do

School of mechanic, Hanoi University of Science and Technology 1, Dai Co Viet street, Hai Ba Trung District, Viet Nam

Abstract: *Ellipse is also used widely on the surfaces of machine parts and appliances. So we must draw many ellipses in engineering drawings. Technical drawing books (TDB) and technical graphics software (TGS), for example: Autocad, Solidworks, Solid Edge ... only give us a way to draw the ellipse when the major and minor (MNA) of it were determined. There are no documents and technical graphics software that shows how to draw the ellipse when two conjugate diameters (COD) of it were determined. Especially, when we draw orthographic projection, eliptical cylinder, eliptical cone, ect… we need to draw many ellipses that two conjugate diameters are determined. That is difficult for the software users. This article will show you how to find the major and minor of the ellipse if two conjugate diameters of it were determined. Finally, we can either use the ellipse command of the software or write a subroutine to draw an ellipse.*

Keywords: TDB, TGS, MNA, COD

1. Introduction

In recent years, there are no commands or icons to draw the ellipse if a pair of COD of it was shown in all graphics software such as: Autocad, Solidworks, Solidedge... Therefore it will be difficult for the users to draw an ellipse when they determined a pair of COD of it. To solve this problem this article will shows you how to determine the MNA of the ellipse from a pair of conjugate COD of it.

2. How to Draw an Ellipse in Some Graphics Software

2.1 How to draw an ellipse in Solidedge software 2018 [1]

2.1.1 Ellipse By Center Point command
The Ellipse By Center Point command draws an ellipse using the center point and two edge points. The center point and the next point define half the length of the primary axis and the rotation angle. The last point defines the secondary axis.
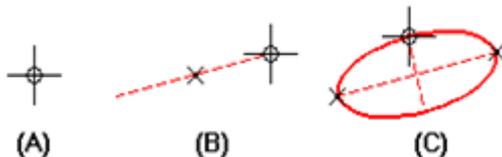
Figure 1: Draws an ellipse using the center point and two edge points

2.1.2 Ellipse By 3 Points command
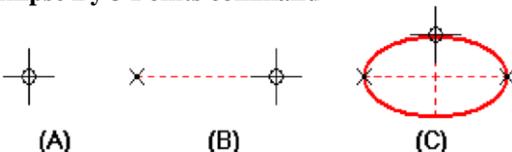
Fig.2 Draws an horizontal or vertical ellipse using the center point and dimentioning its MNA axis

2.2 How to draw an ellipse in Solidwork software 2018 [2]

- Click Ellipse on the Sketch toolbar or Tools> Sketch Entities > Ellipse.
- Click in the graphics area to place the center of the ellipse.
- Drag and click to set the major axis of the ellipse.
- Drag and click again to set the minor axis of the ellipse.

2.3 How to draw an ellipse in Autocad software 2018 [3]

2.3.1 Draw a True Ellipse Using Endpoints and Distance
- Click Home tab Draw panel Ellipse drop-down Axis, End. Find
- Specify the first endpoint of the first axis (1).
- Specify the second endpoint of the first axis (2).
- Drag the pointing device away from the midpoint, and click to specify a distance (3) for half the length of the second axis.
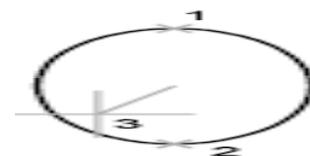
Figure 3: Draws an ellipse using two end points of first axis and a half length of the second axis

2.3.2 Draw an Elliptical Arc Using Start and End Angles
- Click Home tab Draw panel Ellipse drop-down Elliptical Arc. Find □ Specify endpoints for the first axis (1 and 2).
- Specify a distance to define half the length of the second axis (3).
- Specify the start angle (4).
- Specify the end angle (5).
- The elliptical arc is drawn counterclockwise between the start point and endpoint.
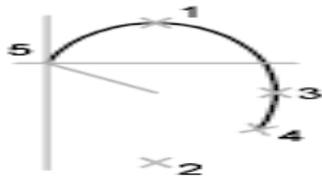
Figure 4: Draws an elliptical arc using two end points of first axis and a half length of the second axis

Finally, to draw an ellipse the software users must determined the MNA of its.

3. How to determine the MNA axis of the ellipse from a pair of COD of it

3.1 An example of such finding the MNA axis from two COD is given in Fig 5
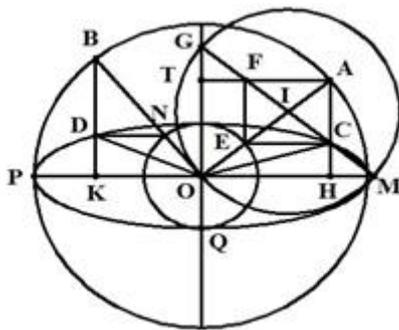
Figure 5: Shows how to determine the MNA from a pair of COD of its

As you know an ellipse is an affine of a circle.
We have the ellipse (see Fig 5).
- OP line is the major axis: OP = a
- OQ line is the minor axis: OQ = b
- Draw a big circle with center point O. Radius of it equal to the length of the major axis. R=a. Draw a small circle with center point O. Radius of it equal to the length of the minor axis R=b. Straight line OA and straight line OB are two Radius of the big circle, OA⊥OB.
- Straight line OC and straight line OD are two COD of this ellipse.
- Draw a vertical line from a point A and a horizontal line from point E. The intersection point of two lines is point C.

 Do the same we can find point D.
- Line OC and line OD are two COD of this ellipse.
- On the contrary, we can find point A and point B from point C and point D like this:
- Rotate right traingle DBN counter-clock 90^0 around base point O → B≡A, N≡E, D≡F
- Quadangle ACEF is a rectangle, Point I is a center point of its.
- So we have four isosceles triangles such as: IEC, IOM, IEF, IOG → OE=FG=CM=b; OA=CG=MF=a.
Finally, we can determine the MNA axis from two COD of the ellipse like these:
- Rotate point D counter-clock 90^0 around base point O. D≡F
- Draw CF line

- Find the middle point of CF line is point I .
- Draw a circle with center point I pass point O.
- The intersection point between this circle and horizontal line OH is point M
- The intersection point between this circle and vertical line OT is point G. The major axis = CG = a, the minor axis = CM= b.

3.2 Using visuallisp to write a subroutine to draw the ellipse by two COD of it

```
(Defun C: ELLH()
(setvar "OSMODE" 1)
(setq  O (getpoint "nPick center point: "))
(setq C (getpoint "nPick end point of  the first COD: "))
(setq D (getpoint "nPick end point of  the second COD: "))
(setq goc1 (- goc (/ PI 2)))
(setq k (distance O D))
(command ".circle" I R1)
(command ent2 (entlast))
(setq G (polar I goc2 R1))
(command ".line" I G "")
(setq ent3 (entlast))
(setq major (distance C G))
(setq minor (distance F G))
(setq F (polar O goc1 k)
(command ".Line" F C "")
(setq ent1 (entlast))
(setq goc2 (angle F C))
(setq L1 (/ (distance F C) 2))
(setq I (polar C goc2 L1))
(setq R1 (distance O I))
(command ".line" O I "")
(setq Diem1 (polar O major 0))
(setq Diem2 (polar O (/ PI 2) minor))
(command ".ellipse" "c" O Diem1 Diem2)
(command ".Erase" ent1 ent2 ent3 ""  ""))
```

4. The results of the draw an ellipse

Table 1: The results of drawing an ellipse in two different ways

How to draw an ellipse	Some results
Here is an old way to drawthe ellipse if the MNA of it were determined**.**	**Figure 6:** Draws an ellipse using the MNA axis of its
This is a new way to draw the ellipse if two COD of it were determined. A new results are given in Fig7.	**Figure 7:** Draws an ellipse using a pair of COD of its

5. Conclusion

The article adds a new method to draw an ellipse in TGS. It helps the software users a new way to draw an ellipse. Base on that they can draw other subjects such as: elliptical cylinders, elliptical cone…in the wireframe, surfaces and the solid model.

References

[1] Help section in Soliedge2019
[2] Help section in Solidwork 2018
[3] Help section in Autocad 2018