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METHODS OF GENERATING AUTOCAD 3D SECTIONS

Abstract: *In this article, the authors present a methodology for teaching in AutoCAD 3D a complete vertical section and a stepped vertical section, from the Computer Aided Graphics Design course, from the Faculty of Automatic Control and Computer Engineering. In this course, students learn how to create a 3D object, and then create sections in the layout, to define and modify them according to European Standards. They thus end up presenting the 3 main views, with section, as well as the axonometric view and the sectioned axonometric view of the 3D object.*

Key words: *AutoCAD, section.*

1. INTRODUCTION

Within the subject matter taught in the presentation of AutoCAD 3D, one of the main types of representations refers to Sections, types of sections and their representation in Layout. In Layout one has to have the views of the object, the view with the section, the axonometric view of the object and the axonometric view of the section, as shown in Figure 1.

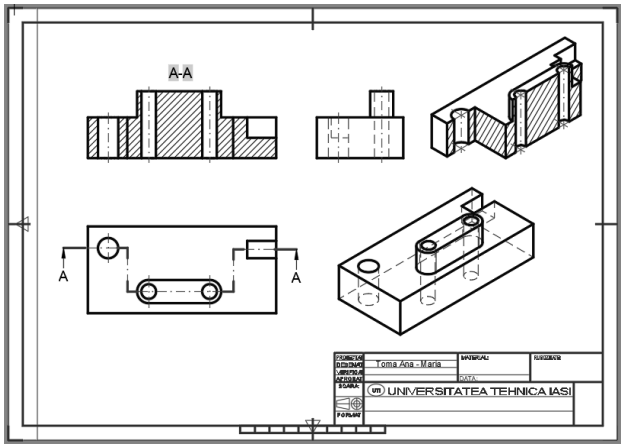

Figure 1 The views of an object, in layout, AutoCAD 3D

Although there are several videos, courses and some tutorials even, about building sections using AutoCAD, such as those presented in [4], [5] and [6], however, the authors felt compelled to create themselves a tutorial that would lend itself to the subject taught to the first year students from the Faculty of Automatic Control and Computer Science, through which they would know how to obtain in layout, after making a 3D object, the necessary views and sections of the object.

But first of all, what is a section?

A section is the orthogonal projection resulting from the intersection of a body with a fictitious sectioning surface and the imaginary removal of the part of the object that is between the observer's eye and that surface (the sectioning plane) [1].

Sections can be classified according to four criteria:

- According to the representation of the section: simple section and section with a view;
- By the position of the sectioning plane relative to the horizontal projection plane: vertical section, inclined section and horizontal section;
- Classification of sections according to the shape of the sectioning surface, in: flat, broken, cylindrical and stepped section;
- Classification of sections according to the proportion in which the piece is sectioned, in: complete, partial and combined sections [1].

The purpose of a section is to provide a better view of the inside of an object, even if that object is a construction or a mechanical part, as it can be seen in Figure 2 [2] and Figure 3 [3] of this paper.

Figure 2 The vertical section of a house

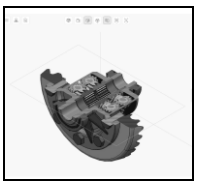

Figure 3 Axonometric section through a gear assembly

In the last course of AutoCAD 3D, the authors provide first the information about sections and then, how to draw them in the AutoCAD.

This article can also be used as a tutorial for drawing sections in AutoCAD 3D, so that in the end, in Layout, the views will present themselves according to European Standards.

2. COMPLETING THE LAYOUT OF A MACHANICAL PART, USING SECTIONS

2.1 Generating the 3D model

The first step in drawing a section in a layout in AutoCAD 3D is to generate the three-dimensional body of the object to be sectioned in the Model space. For this, the three-dimensional space is prepared by arranging the coordinate system on the SW Isometric mode and the visualization of the 3D body of Conceptual type. This is only a preference of the authors, this way of representation being, subjectively speaking, the clearest type of visualization. The 3D body is drawn starting from one of the faces and then with the commands dedicated to 3D, such as Extrude or Presspull and Sweep, the three-dimensional object is generated, taking into account the dimensions from the initial data. If it is a complex object, it is generated by summing up several types of objects or generating cuts and carving, metaphorically speaking, from a larger object, as represented in Figure 4.

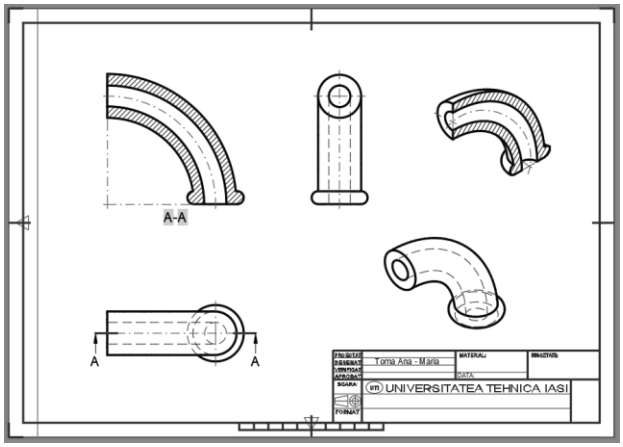

Figure 4 A model designed with torus and cylindrical elements

In the case of the AutoCAD 3D course taught by the authors, two 3D objects are chosen as examples, and in both cases the construction starts from the view above. On one of the objects will be applied a vertical section in steps, and for the second, a total vertical section. The first object is an asymmetrical object, of the type shown in Figure 5, to which a stepped section is applied and which will have the main view with section.

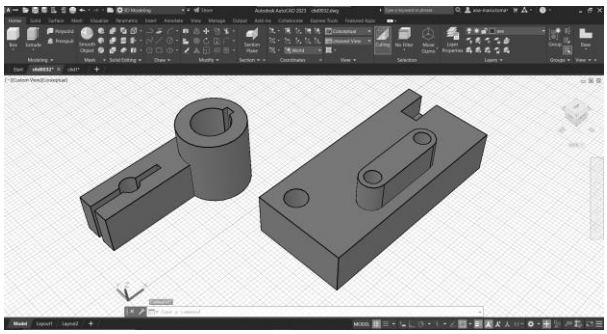

Figure 5 Asymmetrical mechanical parts

The second type of object is a symmetrical object in one direction, a straight polygonal prism or cylinder, to which a total vertical section is applied, which will make the side view sectional. This object will be modeled after those shown in Figure 6.

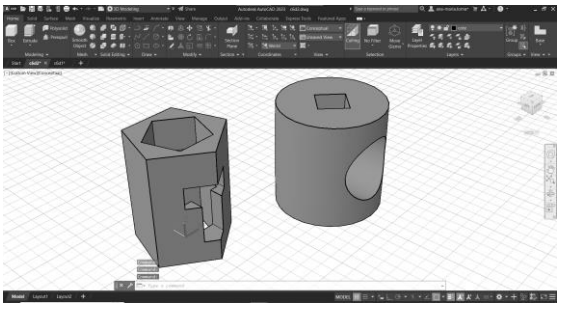

Figure 6 3D model of two symmetrical objects

After the 3D model was generated, in both cases, there are some general steps to be done, in order to achieve the proper layout, in which to have the representation of the views and of the sections.

2.2 Layout representation

- **Step 1**: The rectangle with the modeled object is erased from Layout 1 and then the "Page Setup Manager" command in selected by right click of the mouse, like in Figure 7.

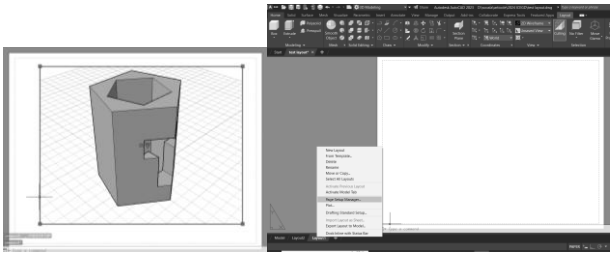

Figure 7 Layout 1 preparation

- **Step 2**: After applying Modify to Layout 1, the following changes have to be made (Figure 8):
  - Printer name: DWG to PDF
  - Paper size: ISO full bleed A3 (420 x 297 MM)
  - Scale: 1:1

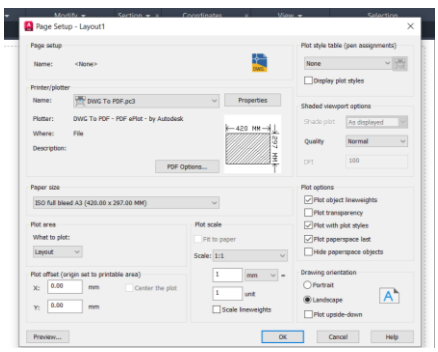

Figure 8 Page setup – Layout 1

- **Step 3**: Before bringing the views of the object to the Layout, one has to apply the A3 Format to the page, which is going to make the page complete and ready to print, afterwards (Figure 9).

Figure 9 Layout 1 with A3 Format

- **Step 4**: Next step is the selection of Drafting Standard to First Angle, which is the European standard of Projection (from the right corner of the screen, press VIEWSTD, like shown in Figure 10)

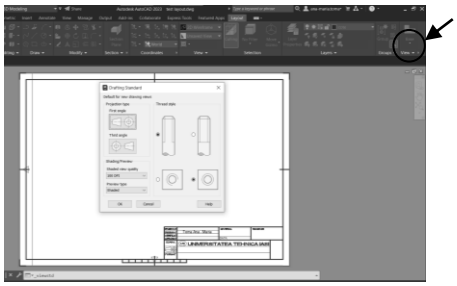

Figure 10 Drafting Standard

- **Step 5**: Next is "Base view from model space" selection, from the right corner of the screen, in the same place as the Drafting Standard window. In this step, the main 4 views of the object are positioned on the paper, the Front view, the Left-hand side view, the view from Above and the axonometric view of the object (Figure 11).

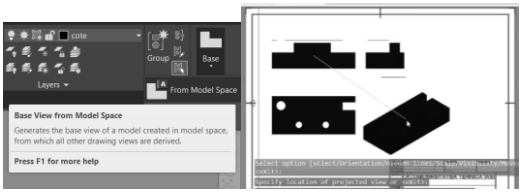

Figure 11 The positioning of the 4 main views of the object

- **Step 6**: Modifying the colors of the layers, the line types and line weight for the MD Visible layer, so it will look presentable to the eye (Figure 12).

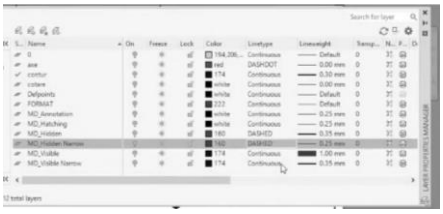

Figure 12 The layers after modification

- **Step 7**: Drawing the section path

- In case of the first object, the nonsymmetrical one, the Section View Offset is chosen, like shown in Figure 13.

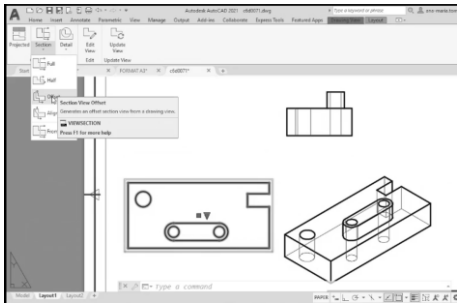

Figure 13 Section View OFFSET

At this stage, the Object Snap Tracking Mode must be ON, so it can help with the section path intersection.

After tracing the section path, the Front view will be raised in its place, having, at first, a black rudimentary color and small elements of the section view, but this is because the section style was not modified yet (Figure 14).

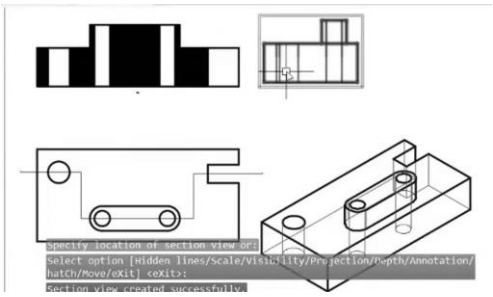

Figure 14 Tracing the section view offset

- For the second object, the polygonal prism, the Section View Full is the best section type, as shown in Figure 15.

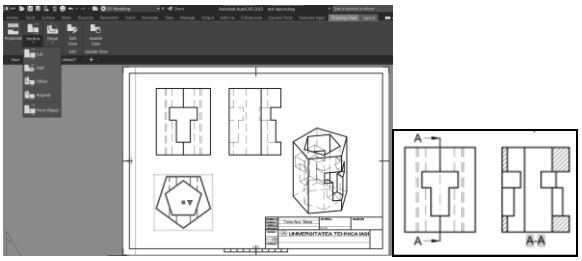

Figure 15 Section View FULL

2.3 Configuring the section style

After tracing the section path, the Section style must be modified, according to European Standards. These changes are made from Section View Style area, in the right corner of the screen, also (Figure 16).

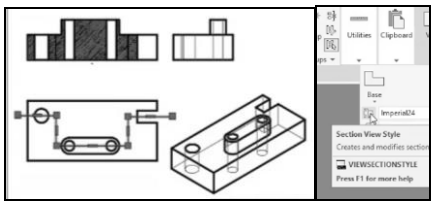

Figure 16 Section view Style

After pressing that button, the Section view style manager appears. Starting from here, there must be created a new Section style, having as a base the ones already there (Figure 17 and Figure 18).

Figure 17 Modify: Identifier and arrows/ Cutting plane

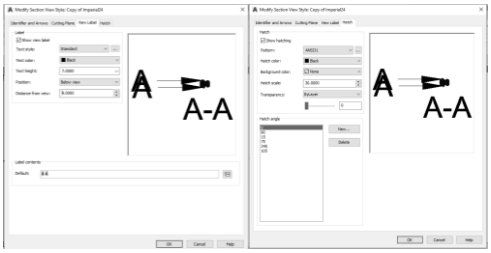

Figure 18 Modify:View label/ Hatch

In the end, the section style that appears on the views will look according to European Standards, which was the main idea of this work (Figure 19)

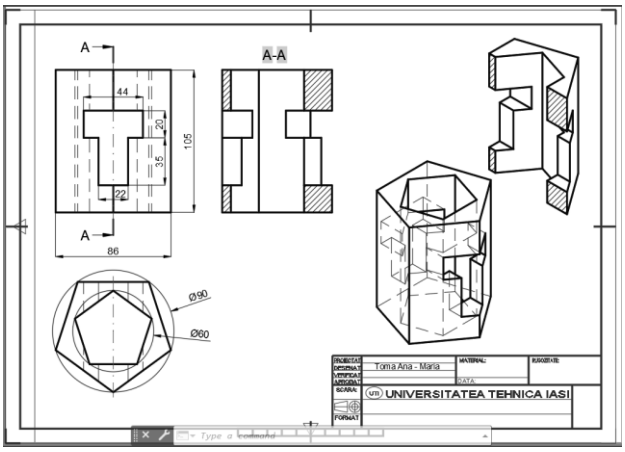

Figure 19 The complete Layout for the Section View Full case object

3. CONCLUSIONS

In conclusion, in this course, students learn how to create a 3D object, and then create sections in the layout, to define and modify them according to European Standards. They thus end up presenting the 3 main views, with section, as well as the axonometric view and the sectioned axonometric view of the 3D object.

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