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MODERN CAD TOOLS USED IN MECHANICAL DESIGN

Assoc. Prof. Ec. Dr. Eng. Adrian Mihai GOANTA
University "Dunarea de Jos" of Galati -Romania,
Faculty of Engineering in Braila, Research Centre for Mechanics of the Machines and Technological Equipments

ABSTRACT

This paper aims to present synthetically as many of those tools that are part of Mechanical Desktop 2008 software with notable performance in the CAD environment and to justify this performance by the presentation of the author's work in the design of the fittings used in furniture manufacturing. Specifically in this work is concerned with the 3D models of the sheet metal parts that form a set of buried type hinge. The author also attempts to show that by even if Mechanical; Desktop 2008 has no instruments of "Sheet Metal", it can still be achieved with additional effort and within certain geometric restrictions of the tin cast pieces into molds category

KEYWORDS: CAD, Design, Autodesk Mechanical Desktop 2008

1. Novelties in grouping the working tools

The main instruments of Mechanical Desktop 2008 which makes it different from the traditional AutoCAD are grouped into falling menus distributed in the upper part of the screen. In these menus, we find elements of innovation related to each menu in the following order:

- Tools applied to files which are grouped into the „*File*" pull-down ;
- Editing tools such as cut / copy / paste which are applied to spare parts grouped under "*Edit*" menu;
- In addition to the traditional visualization tools (such as *zoom, pan, blinded*), seen in AutoCAD or its older version, the no. 6 of the Mechanical Desktop, in the menu "View" there are new tools such as *Camera, Walk and Fly, Screen Clean, Create Room, Motion Path Animations.*
- Assistance tools grouped in the "*Assist*" menu which in addition to the traditional elements also contains new elements of the type workspaces, *Palettes, Layer / Layer Group, Language, Language Converter, Image Display / Save, Drafting Settings*, etc.
- Classical and new design tools such as PolySolid*, PlaneSurf, Helix, Table, Gradient, Special Lines, etc.*
- Tools to generate pieces of the type: *Scale Part, Reorder Feature*.
- Drawing tools are generally those in Mechanical Desktop 6, but in the dialog window on a new generation of views there is an additional window that allows selection of the space orientation of the item to be drawn, as shown in Figure 8.
- The tools of annotation on drawing contain new elements such as: *Hole Carts, Fits List.*
- Tools to use 2D/3D libraries are combined in a single pull-down and do not feature significant changes to the *Mechanical Desktop* 6.

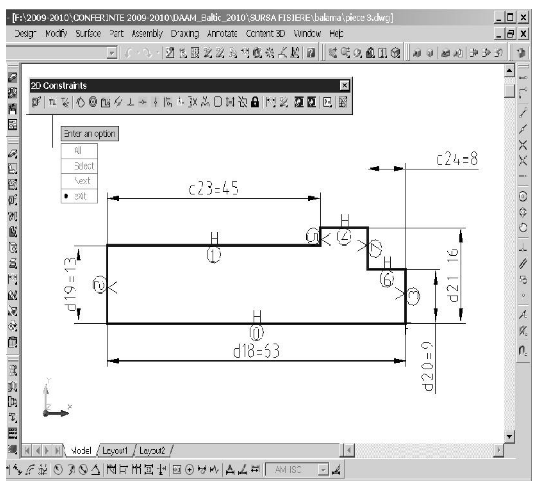

Fig. 1. Completely defined sketch

It should be, noted that in the falling menu associated with the surface generation or achieving three-dimensional assemblies, there are no significant changes.

2. 3D designs generation tools by parameterized design method and the results of their application

To obtain a parametric part, the following stages must be reached;

- Define the three projection plans by command _ambasicplanes;
- Draw sketch preferably of mobile contour with commands from Design pull-down site;
- Transform the sketch into profile by command _amprofile profile;
- Define and edit constraints by command amdt_show_cons cu for the purpose of obtaining the message Solved fully constrained sketch in the control line;
- At the end of the previous stage the sketch is fully parameterized and can be successfully used in the next step to generate 3D items, with commands such as Extrude, Revolvers, Loft, Face Split, Part Split, Sweep, Rib, Bend.

Figure 1 presents the initial draft of Profile type, 2D geometric restrictions that are a starting point in designing a piece of jacket type.

In most cases of generating 3D parts, the first command is Extrude or Revolve, and in its next steps the other commands mentioned above it resorted to.

For example, for the piece of the metal sheath type, also called Part number 1, represented in Figure 2, the sequence of generation commands is shown in Figure 3, namely *ExtrusionBlind, Chamfer, Shell, ExtrusionToFace, ExtrusionBlind, ExtrusionFromTo, Fillet*, some of which may be applied several times. As seen in Figure 3, the Shell command has replaced the need of the commands *Sheet Metal* which accompany other design software packages for modelling sheet metal parts, but it must be underlined that *Mechanical Desktop 2008* cannot generate the evolvent of the piece designed.

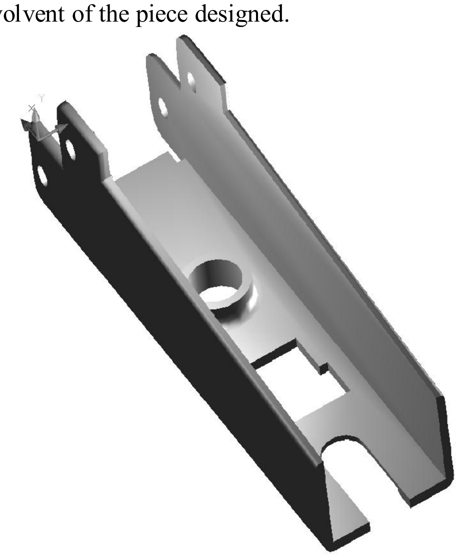

Fig. 2. Piece of the metal sheath type

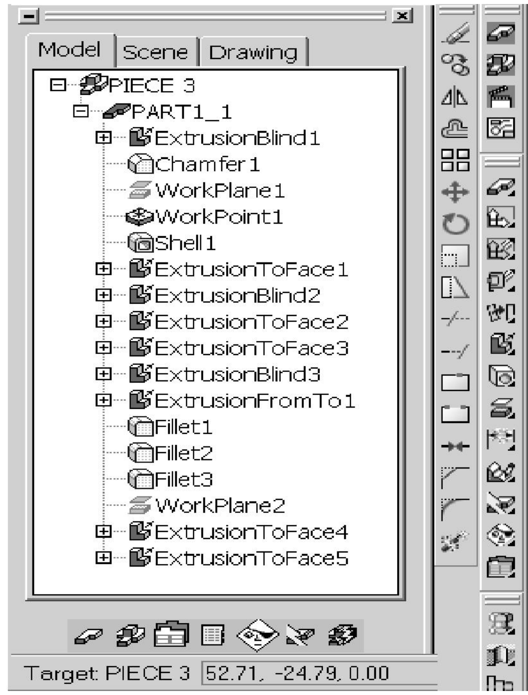

Fig. 3. Sequence of commands applied to the sheath type piece

Similarly, with the above steps different pieces of simple or complicated geometry can be obtained. Figure 4 illustrates, in the order of their application, the commands to generate the sheet piece which will be embedded into the wooden board of the furniture: *ExtrusionBlind, Hole, Shell, ExtrusionPlane, ExtrusionToFace, ExtrusionThru, and Fillet.*

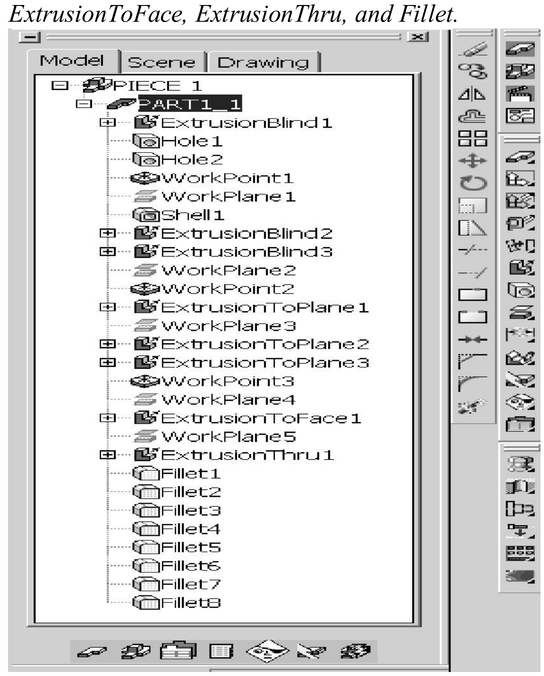

Fig. 4. Sequence of commands applied to the embedded piece

Forma the geometrical shape corresponding to the metal sheet piece number 2, to be embedded into the furniture wood, is shown in Figure 5. As it can be seen from Figure 4, in this case too, the initial command is of the type *Extrude* and the one determining the appearance of the sheet piece is the *Shell* command.

The Mechanical Desktop has the capability to assign to the piece properties of material by means of *Mass Properties* command, which includes in an internal database properties starting with density up to *Youngs Modulus, Poissons Ratio, Yield Strength, Ultimate Tensile Strength, Thermal Conductivity, Linear Expansion* and *Specific Heat*. If the material used for piece execution is not found among the materials from the pre-defined library of the software, the designer has the possibility to define a new material of preset name and properties.

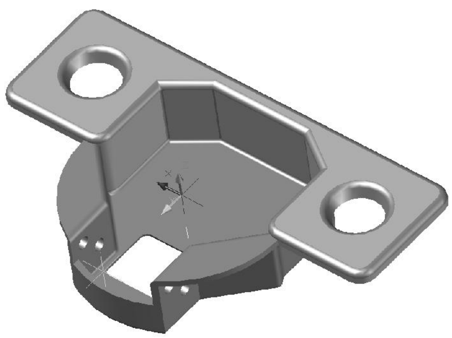

Fig. 5. Sheet piece number 2

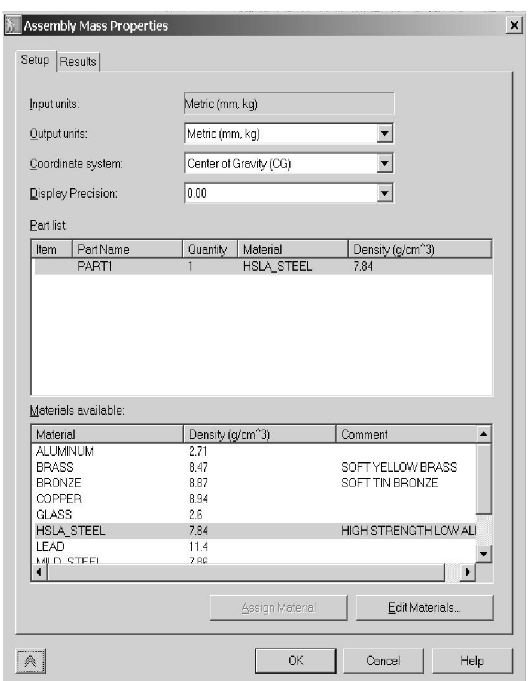

Fig. 6. The window corresponding to *Mass Properties command*

The *Mass Properties* command is to be found in pull-down Part menu, opens the window in Figure 6, and after having applied the material to the piece allows, based on the input data (the measurement system, the system coordinates and accuracy chosen) for the instant calculation of the mass, volume, lateral area, inertia moments, rotation radii, principal moments of inertia and determines the position of the main axes. The window in which the designer can choose the material properties assigned to the piece is shown in Figure 6, and the window containing the calculation results is shown in Figure 7.

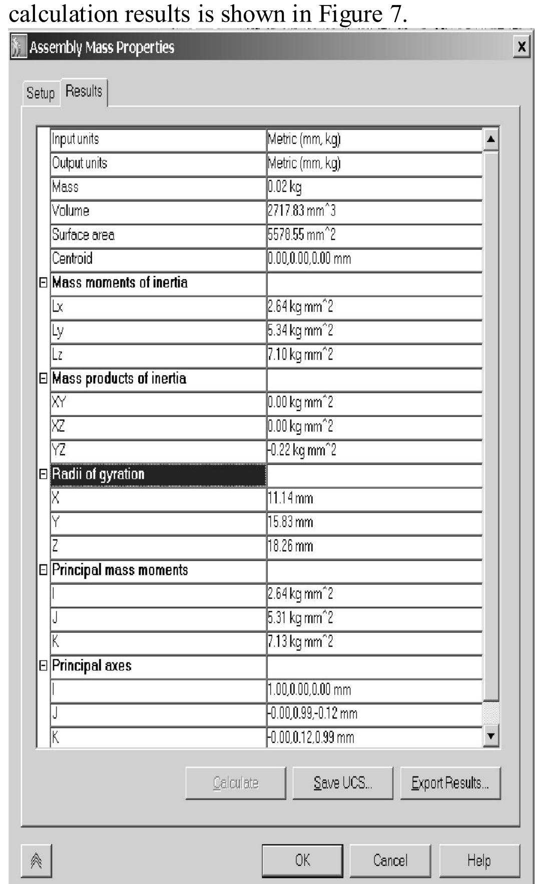

Fig. 7. The window with the calculation results

3. 2D designs generation tools and their application results

Tools for generation and drawing 2D graphics are in the pull-down sites: *Drawing and Annotate*. The command for initiating drawing on the paper spread is *New View* or *Multi-View* and both open a new window shown in Figure 8, which shows that one can choose the type of projection of the element to be drawn, the sheet of paper on which to draw, how to choose the orientation in space, namely the choice of axis "X" direction, the drawing scale, the elements of setting hidden lines, selection of section and representation of standard parts.

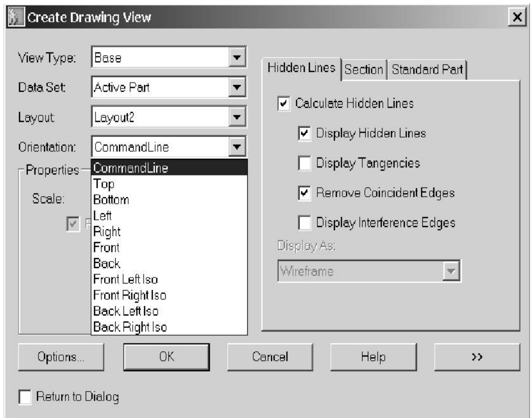

Fig. 8. Drawing generation window

When working on paper other than standard ones, which contain additional customized boxes, one must first define these formats and then proceed with the drawing. It is recommended to use the version of achieving in turn the desired projections since it is much easier to make further changes on the paper. The projections obtained will not contain all the dimensions necessary to define geometric shapes, even if the transposition of all parameterized items is set, and therefore the commands from the „ *Annotate*" pull-down are resorted: *Power Dimensions, Edit Dimensions, Hole Charts, Text, Annotation, Symbols, Symbols Edit, Leader Notes*, etc.

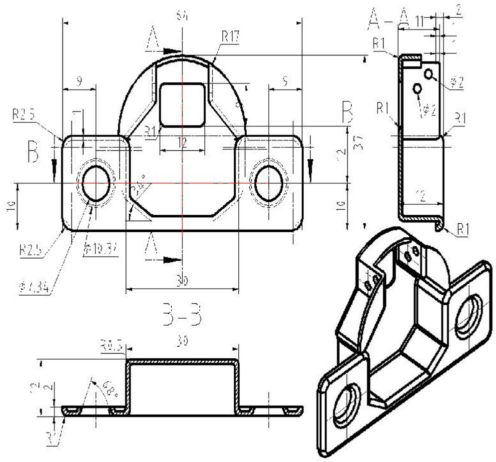

Fig. 9. Drawing of piece no. 2

Figure 9 illustrates for information purposes, the execution of the sheet piece number 2.

If applied around the same tools as those mentioned above one can obtain (Figure 10), the axonometric and orthogonal projections of the piece number 1.

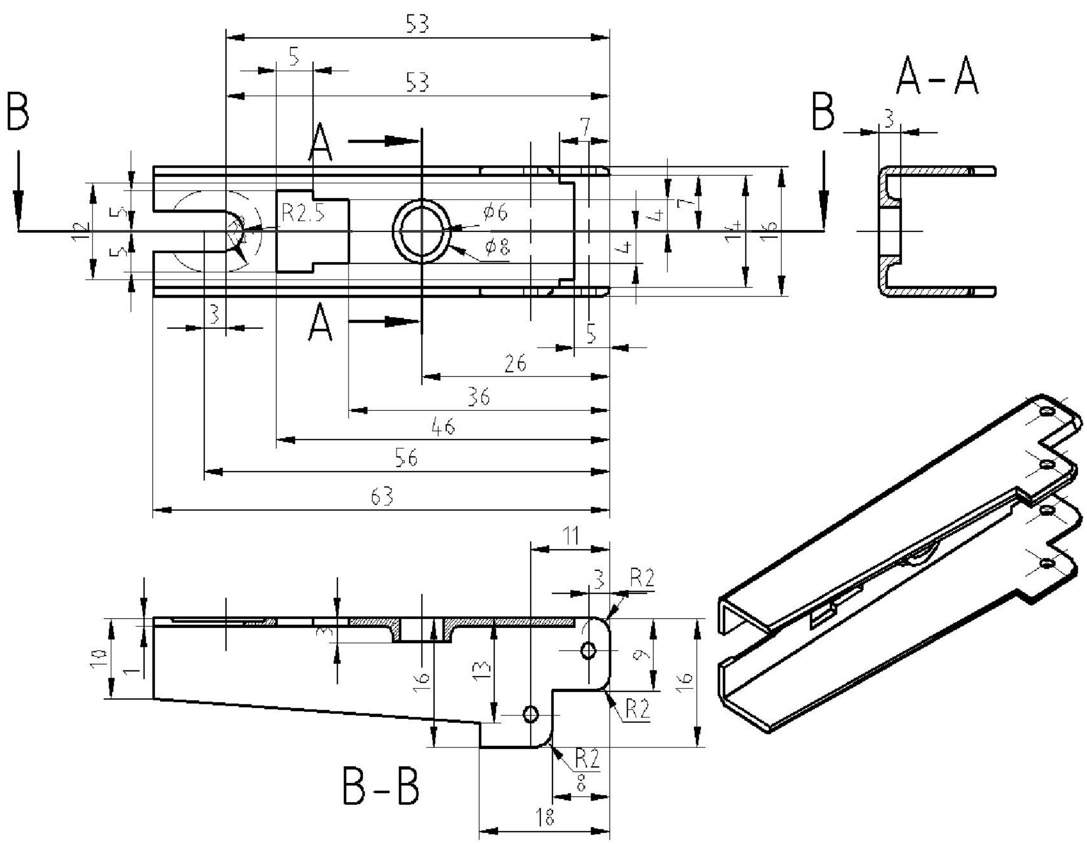

Fig. 10. Drawing of the sheath piece

4. 3D assemblies generation tools and their application results

Using the 3D assembly pattern, a new file can be obtained. The steps to obtain the 3D model of the assembly are:

- Declaration of intention to make an assembly with the command *amdt_assm_modeling*;
- Launching command *_amcatalog* which allows for the localization of the file directory and insertion of each piece to make up the desired assembly;
- Impose 3D restrictions on the reciprocal positions of the pieces in the assembly by means of the commands: _ammate, _amflush, _amangle, *_aminsert*.
- Editing pieces where there are mounting errors and their final saving the working directory;
- Add standardized items for the assembly and completion of the 3D assembly;
- Defining the modalities of shading on the overall design, by launching command *_ampatterndef,* which allows the establishment of one type of shading for each piece of the assembly.

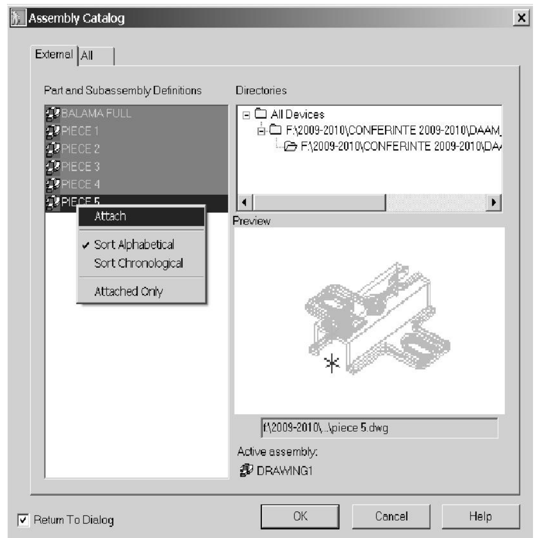

Fig. 11. *Amcatalog command window*

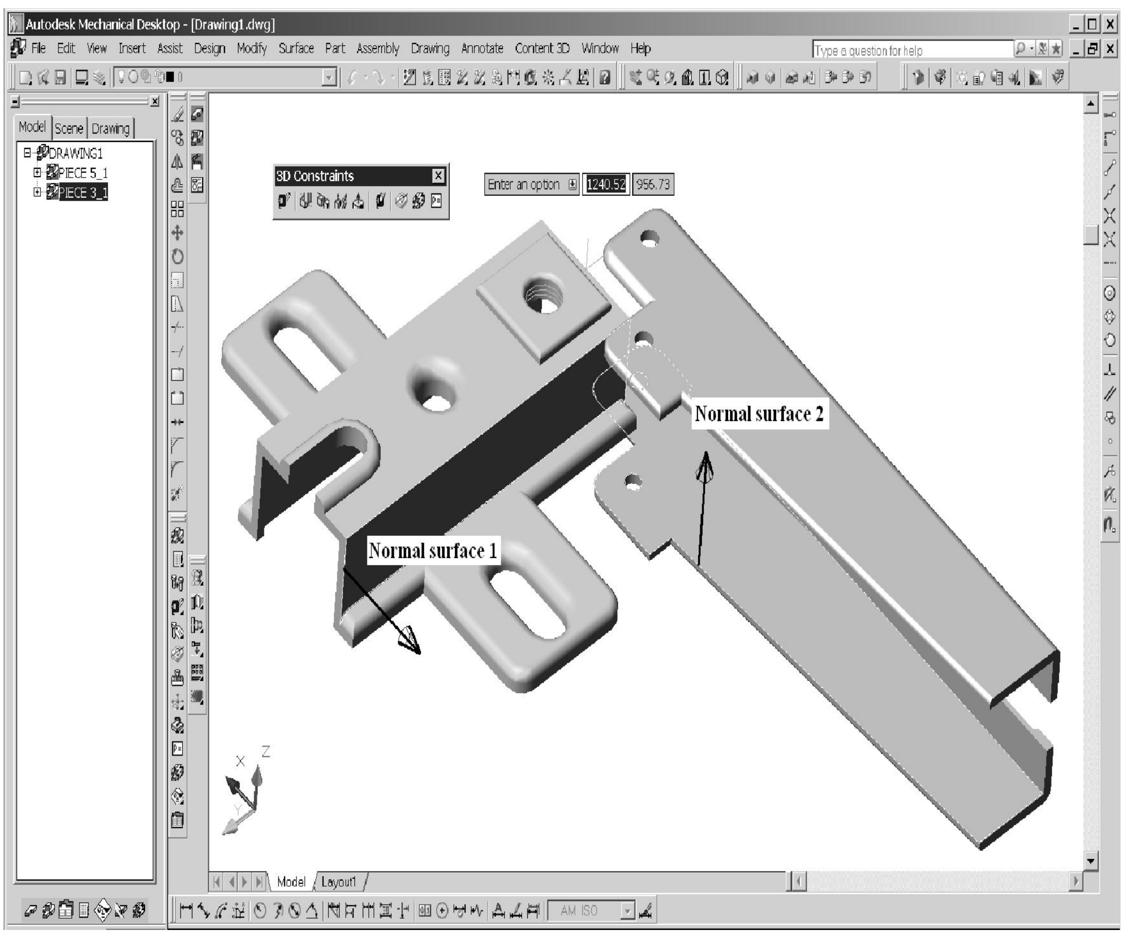

Fig. 12. Imposing co planarity

For example, with the assembly that contains metal mold pieces, the window used to insert all pieces related to the hinge being studied, is shown in Figure 11. It should be noted that the first piece inserted into the assembly is called fixed piece of background type according to which all other restrictions on the relative position of the pieces placed one by one are established. Imposing restrictions 3D, of mutual position, is always made for two selected pieces, one by one, until all parts inserted are fixed within the modelling space.

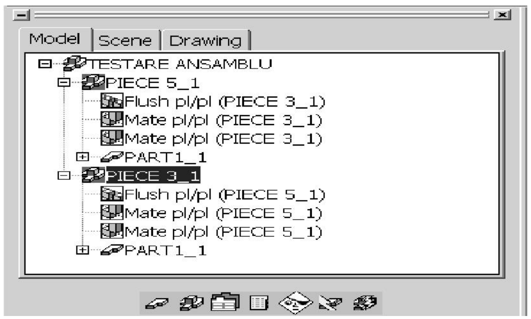

Fig. 13. 3D positioning restrictions in Desktop Browser

In Figure 12 one can see how normal of two surfaces are selected in order to impose their co planarity and in Figure 13 one can see the emergence of all 3D restrictions on mutual positioning in the Desktop browser in the window left side. As shown above, the next step is editing those pieces inserted which cannot be mounted in normal conditions. Since this is not our case Figure 14 illustrates the window introducing the standardized components in the overall assembly, which in this situation only involves the standard tightening screws.

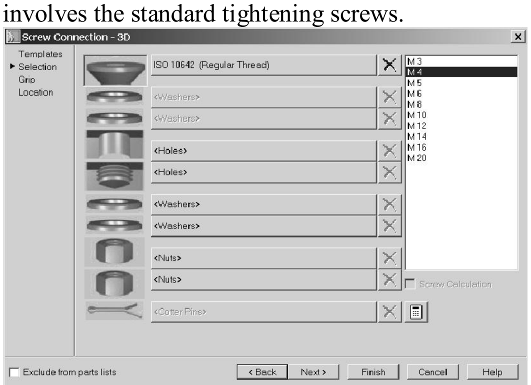

Fig. 14. Modality of inserting the tightening screws

Following the classification at the beginning of this chapter it is found that the last stage referred to is reached, namely to establish the types of shading achieved by _*ampatterndef* command, which opens the window shown in Figure 15.The end result of the sheet mold assembly is shown in Fig.16.

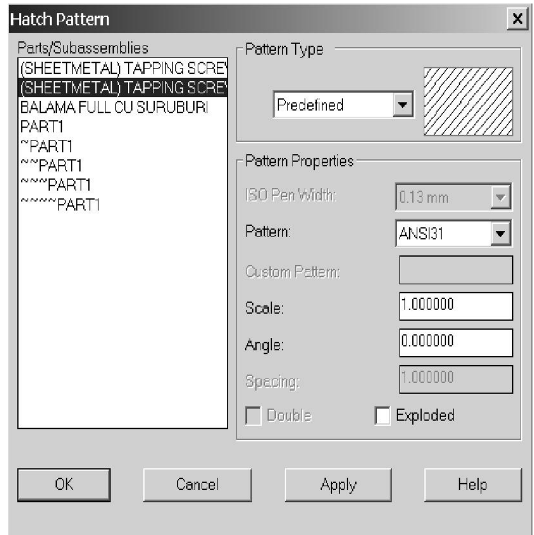

Fig. 15. *Ampatterndef* command window

5. Studies and future research

The author's activities in the future will be directed to both establishing a methodology for developing a graphical documentation of sheet assemblies and importing/exporting sheet pieces among the specialized software of this time.

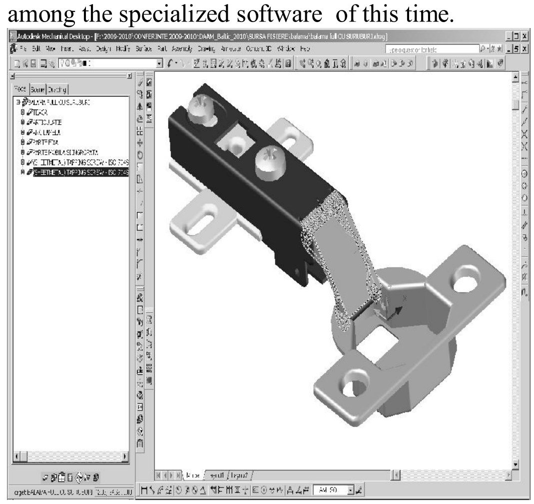

Fig. 16. The assembly consisting of sheet pieces

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