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COMPARATIVE STUDY ON THE APPLICABILITY OF "EXTRUSION" COMMAND IN THE DESIGN SOFTWARE TAUGHT IN HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

The paper aims to present a comparative study of "Extrude" control/command or equivalent controls that are found in the following design softwares: Mechanical Desktop 6, Solid Edge v. 20 and Solid Works 2008. In other words all variants of the command are studied comparatively and the features of each of them are highlighted.

KEYWORDS: CAD, Mechanical Desktop 6, Solid Edge v. 20, Solid Works 2008

1. INTRODUCTION – EVOLUTION OF SOFTWARE IN ACADEMIC CURRICULA

Since 1990 when the strategic partnership between the Ministry of Education and the American company Autodesk Inc. was celebrated, we have all seen the introduction and development in time of new disciplines that use different software design, modelling and analysis. The first step was made by introducing into the curricula for engineers, (mechanics first and then other specialties), the discipline based on AutoCAD. This discipline took different names, starting with the name of the software as such and continuing with the technical graphics, computer graphics, and computer aided graphics, etc. However, as both hardware and software design has developed, the Romanian higher education had to adapt to the new premises created by specialized companies which initially required employment of both engineers and students with solid knowledge of computer aided drawing and then with knowledge and skills in various three-dimensional design software

Thus technical colleges, in order to keep up with industrial firms, had to purchase or receive free usage of those software packages that were required upon employment by the companies in the country or abroad. Reality has shown that Autodesk products began to be taught by students and thus increased the prevalence in the business of these products, due to the fact that firms using such software had lower costs of implementation, because the ready -trained workforce came directly from the technical faculties. In other words, strategic partnership made in 2002 opened a new phase of collaboration between academic staff and representatives of Romanian design firms, in that almost all these companies, realizing the beneficial effect of free offerings to technical universities, have assimilated the model of collaboration of Autodesk Inc., and Ministry of Education and moved on to providing free educational license to universities or directly to students. Thus a series of advanced software design, analysis and simulation of virtual manufacturing, such as Autodesk Inventor, Solid Edge [3], Mechanical Desktop, Solid Works [4], Catia, NX, have entered academic world generally free or through European projects. It should be mentioned that each software manufacturer has its own marketing policy, but they keep their eyes on the competitors. At this point, the U.S. company

Autodesk Inc. initiative opened a new stage of promotion of educational software implying free offering directly from the site to both academics and students in Romania, of free license featuring the same capabilities as the commercial ones, the only difference being that the educational version has on the frame format the term "educational version printed".

2. DESCRIPTION OF "EXTRUDE" COMMAND IN MECHANICAL DESKTOP 6

Mechanical Desktop 6 is 2D/3D design software made by Autodesk Ink. in 2002 which deserves special attention because it works on a lower configuration PC, having however remarkable modelling results. I say this because it is one of the few softwares at this point that makes a bi-univocal correspondence between the spatial modelling and drawing. The "Extrude" command is similar to that of AutoCAD, noting that the solid generated is a parameterized one, i.e. in other words, if the modelling sizes are altered, the solid itself will be changed. To make the best of this benefit, in relation to AutoCAD, the following steps should be followed:

✓ Introducing in the modelling space the working planes of the type "Work Plane" (fig. 1);

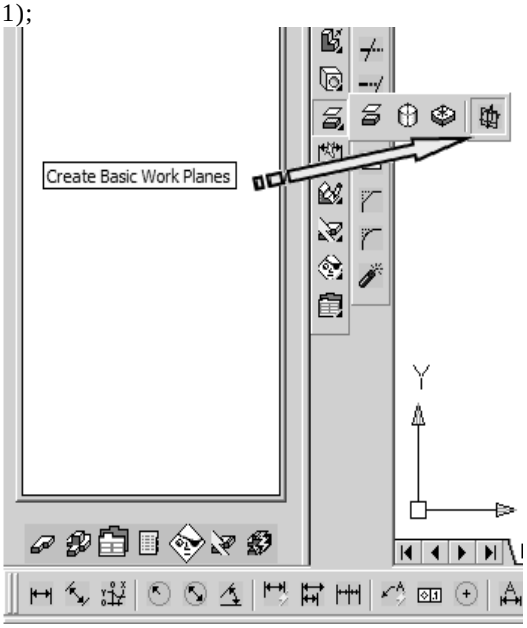

Fig. 1 Defining "Work Plane"

✓ Declaring the sketch plan with "New Sketch Plane" control and selecting the orientation of the coordination system (fig. 2);

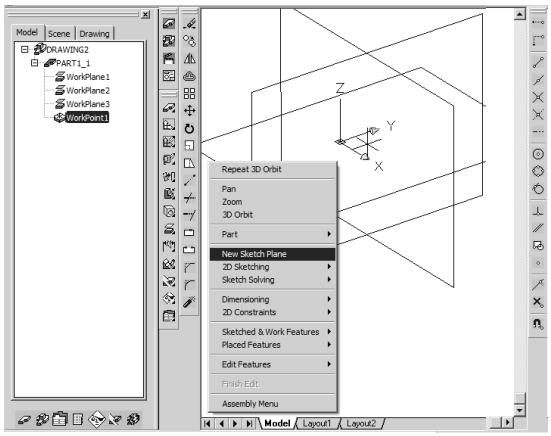

Fig. 2 Declaring the sketch plan

✓ Drawing the sketch and defining the profile;

✓ Sizing and imposing bi-dimensional geometric constrains (fig.3);

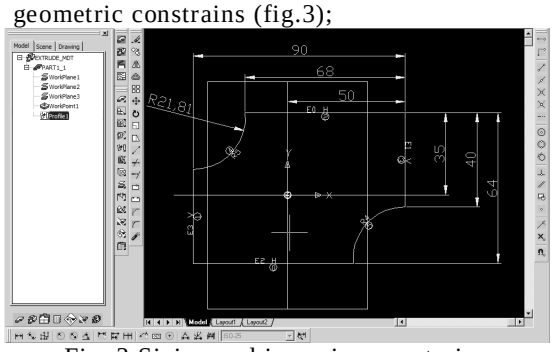

Fig. 3 Sizing and imposing constrains

✓ Performing the extrusion command (fig. 4).

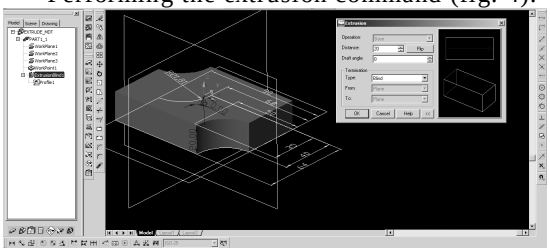

Fig. 4 Performing the extrusion command

3. DESCRIPTION OF "PROTRUZION" COMMAND IN SOLID EDGE

Since version 20 of Solid Edge software is much more recent than version 6 of the Mechanical Desktop, it is found that the application of the command equivalent to "Extrude" command, which here is called "Protrusion", is much easier due to the following facts:

✓ Sketch planes are inserted while opening the file type *.par (Fig. 5).

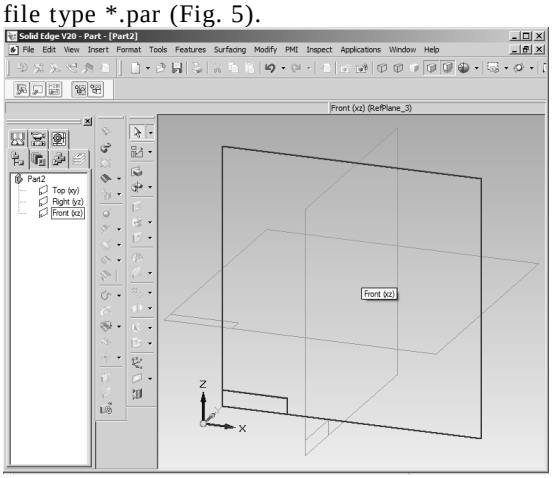

Fig. 5 Initial sketch planes

✓ Drawing the sketch involves the automatic generation of a parameterized profile.

✓ Sketch editing commands are much easier to apply. One example is the Cutting command "Trim", which is more performante than the same command in Mechanical Desktop as a single mouse movement can cause the cutting of several geometric drawn elements (Fig. 6).

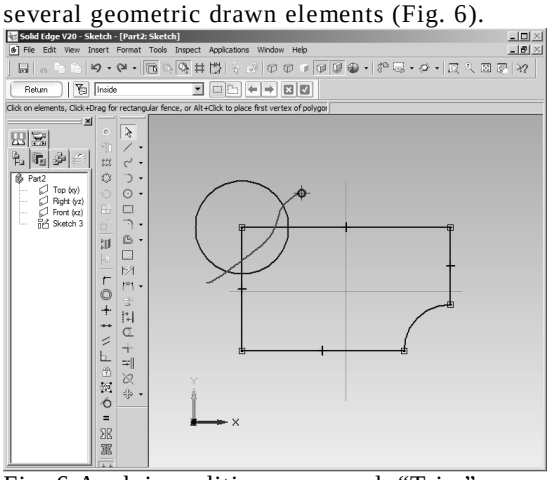

Fig. 6 Applying editing command "Trim"

✓ The constraints applied automatically to the sketch are marked with symbols that take much less space of the modelling area.

✓ If the profile-type sketch of Solid Edge is edited after the initial generation, it automatically gets constraints, unlike Mechanical Desktop, where the new graphic entities had to be added by summing up to the initial sketch and later new constraints are imposed for the total result. This shortens the design period when using Solid Edge.

✓ The process of generating the solid is viewed in real time for Solid Edge [1], which allows for a more rapid determination of possible modelling errors (Fig. 7).

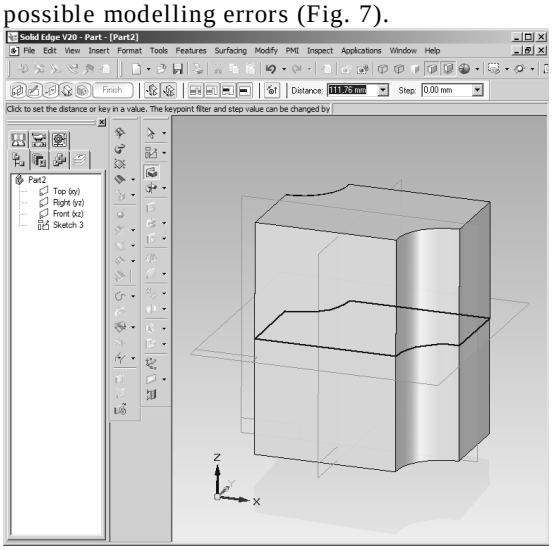

Fig. 7 Real-time viewing of the "Protrusion" command

✓ "Protrusion" command in Solid Edge is much better than "Extrude" from Mechanical Desktop as it has two additional options for modelling, namely "Draft" to control two angles of inclination (Fig. 8) and "Crown" with multiple settings (Fig. 9).

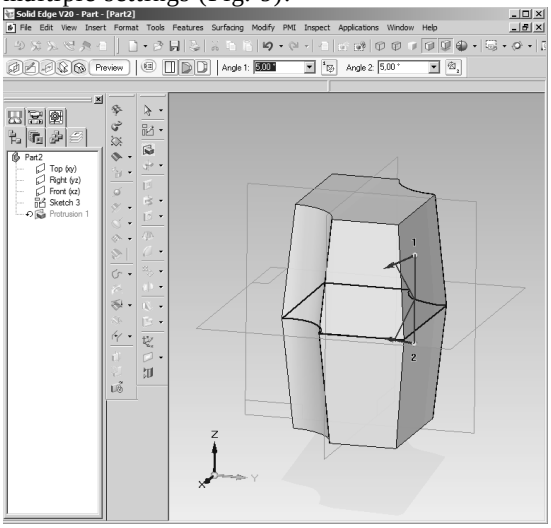

Fig. 8 "Draft" option of "Protrusion" command

This last option allows the designer, by setting certain parameters, to modify the geometric shape from within the command "Protrusion". Thus the side edges can be curved with a certain radius of connection as shown in Figure 9, or this parameter can be combined with the start inclination angle of the same edge or other two parameters can be combined, namely a certain offset from the end edge with the angle of inclination at the start of the same edge. These settings allow changing radically the initial geometry obtained by the command

"Protrusion".

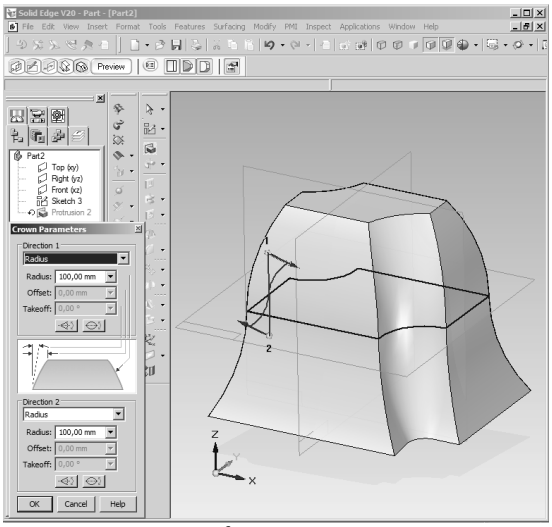

Fig. 9 Parameters of "Crown" option

✓ "Protrusion" command allows for a dynamic editing of each parameter as shown in Figure 10.

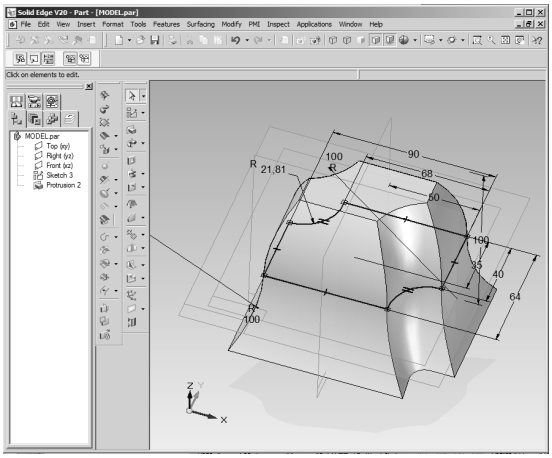

Fig. 10 Dynamic editing of "Protrusion"

4. DESCRIPTION OF "EXTRUDE" COMMAND IN SOLID WORKS 2008

Solid Works 2008 version came on the software market around the same time with Solid Edge V20, both being 3D design softwares and also lower versions of competitors: Dassault Systems [2] and SIEMENS. Top products of these two companies are Catia and NX. In terms of resources consumed by the two software packages, it must be noted that both consume about the same hardware resources. Since the starting of Sold Works it, has been found a layout optimization compared to the two previously studied softwares in that all commands in a certain category are grouped unitarily, forming a ribbon-type arrangement specific to the years after 2010. Returning to the subject of the comparative analysis the following features in the application of the command "Extrude can be found:

✓ The sketch plans exist since opening the file type *. Sldprt, but they are not visible, that is why they should be provided with visibility property or this should be set for all files to be opened further (Fig. 11).

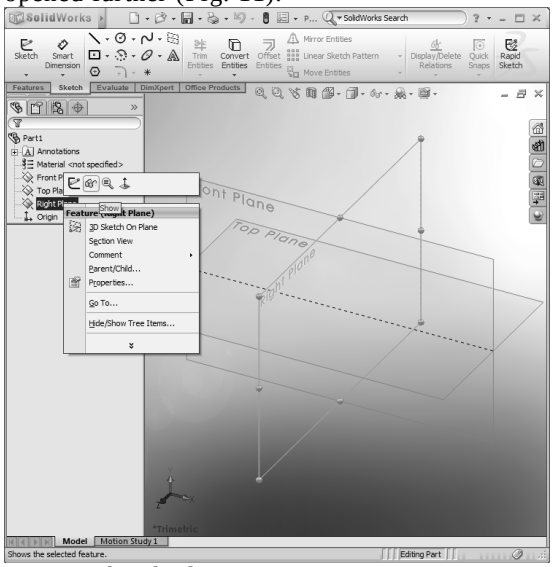

Fig. 11 Sketch plans SW

✓ Resolution of the "Feature Manager" zone is superior to the other two softwares studied which results in less space occupied from the modelling area. Also the command "Schetch" shows the version "3D Sketch"

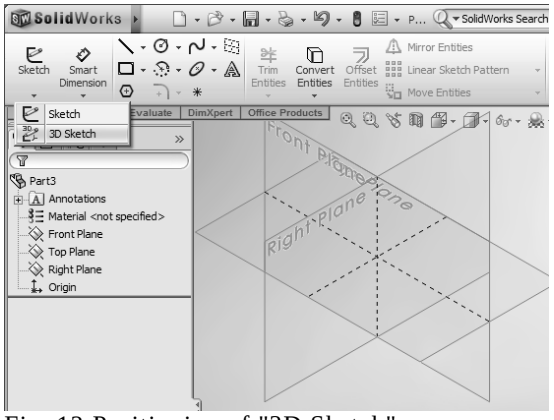

Fig. 12 Positioning of "3D Sketch"

✓ Sketch editing commands are similar to those in Solid Edge. At the command "Trim" level, it is found the performance of simultaneous cutting of several graphic entities by simply moving the mouse.

✓ Constraints that apply to graphic entities are

very performing as they allow for further constraints including at selected points. Figure 13 presents the window imposing the verticality constraint for two selected points.

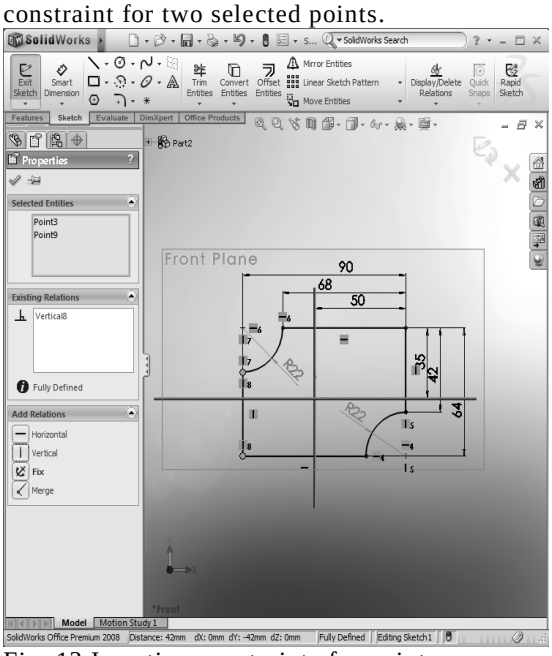

Fig. 13 Inserting constraints for points

✓ Also, like Solid Edge, when editing the sketch, the new elements automatically receive dimensional constraints.

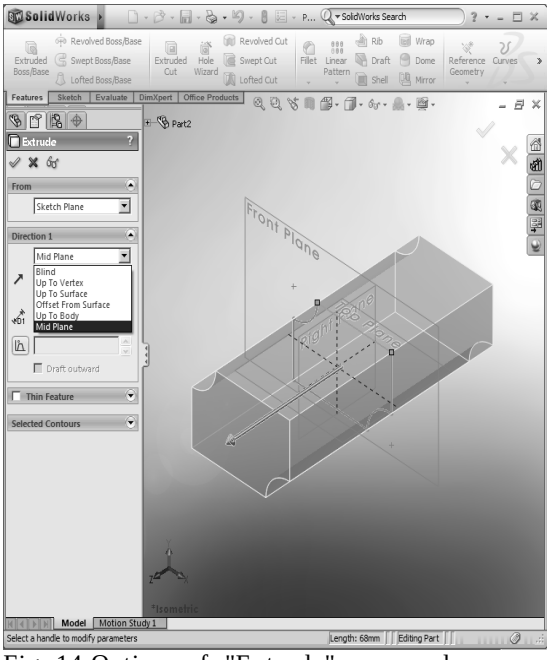

Fig. 14 Options of "Extrude" command

✓ Possibilities of setting the command "Extrude" are similar to the Solid Edge ones (Fig. 14).

✓ Similar to Solid Edge, Solid Works 2008 version presents the opportunity of dynamic visualization during extrusion of the solid only in the wire network by a mouse click on the vector that suggests the extrusion direction (Fig. 15).

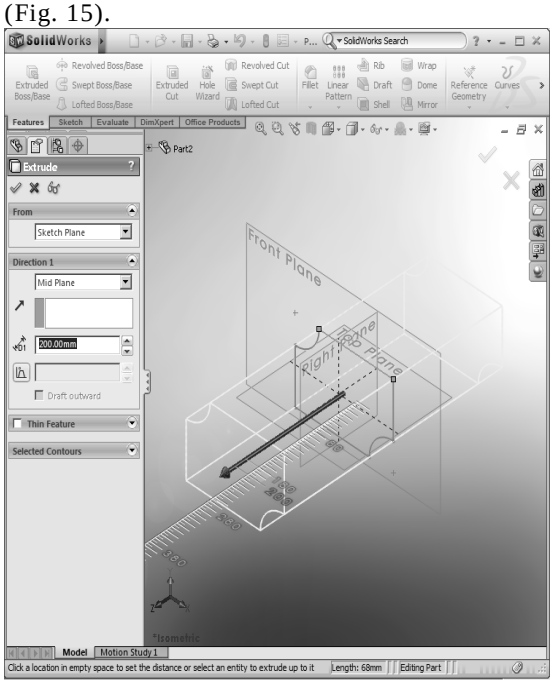

Fig. 15 Dynamic visualization of "Extrude" command

✓ Unlike Solid Edge, Solid Works for allows only option "Draft" inside the command "Extrude". The application and effect of this option are presented in Figure 16.

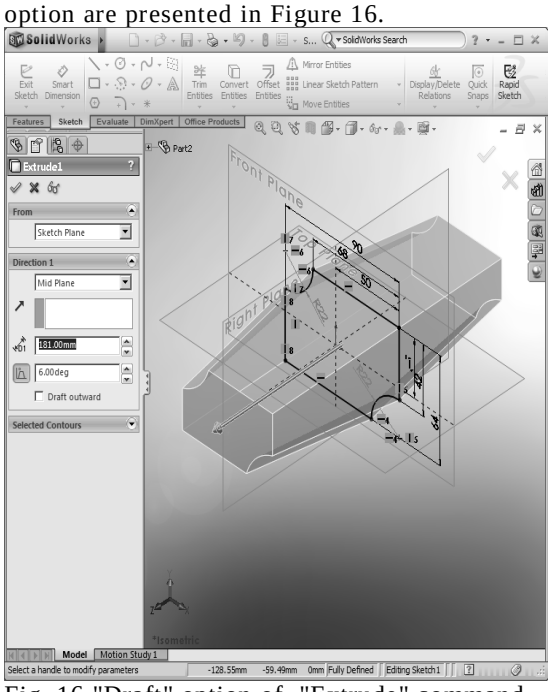

Fig. 16 "Draft" option of "Extrude" command

✓ Unlike Mechanical Desktop 6 and Solid Edge V20, the Solid Works version studied allows in certain situations for a clear viewing of the browser after commands are performed (Fig. 17).

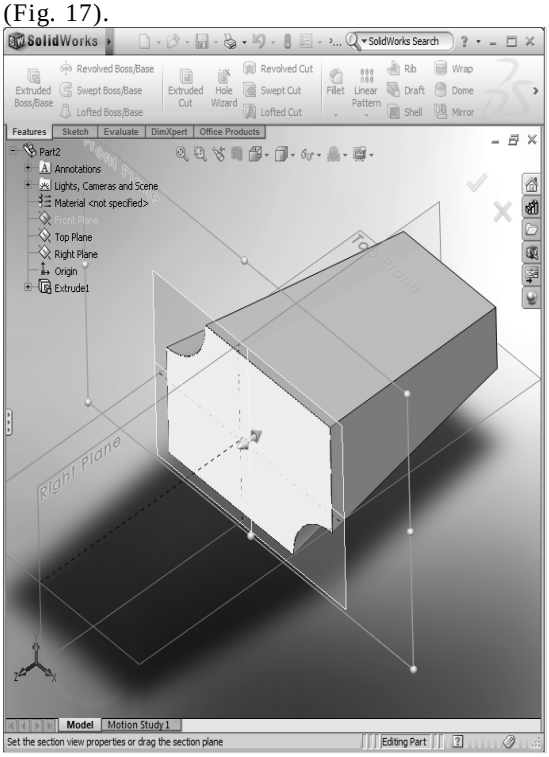

Fig. 17 Clear viewing of the browser

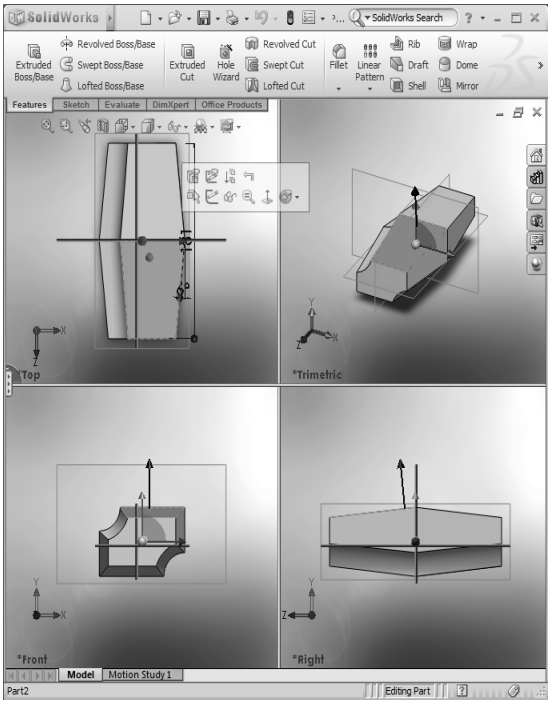

Fig. 18 View in viewing

✓ The most spectacular part when viewing the solid obtained by extrusion, was the division of the screen into multiple windows where the model was designed in the American system of projection.

Even though that view is specific to Autodesk products, the novelty is that by selecting a particular object side, an automatic viewing of that side occurs in each of the screen windows. Even in a particular situation, when the selected surface is perpendicular to the working window, the Selected Work indicates this by marking the normal to the surface (Fig. 18).

5. CONCLUSIONS

The comparative analysis of the "Extrude" command to generate solids, point out that the variants of Solid Edge and Solid Works fight for primacy. If we try to restrict the examination to these two software, the analysis becomes very complicated because each of the two variants presents simultaneously both strengths and weaknesses, as follows:

a. Solid Edge is more powerful in terms of actual command "Extrude" due to the two options, "Draft" and Crown ".

b. Solid Edge allows for the dynamic editing that further allows viewing and editing of all dimensional parameters.

c. Solid Works has a greater ability to impose geometric constraints at the sketch level, in that it allows for constraints applied at point level.

d. Solid Works allows for the visualization of multiple View ports.

Finally we should mention that the analysis remains open for other commands from the mechanical design, analysis to be continued in other works by the same author.

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[3] http://www.solidedge.co.za/ Accesed: 23.08.2011

[4] http://www.solidworks.com/sw/industries/engineering-education-software.htm Accesed: 05.08.2011