

# CONSIDERATIONS ON DESIGN CONTROLS INTENDED TO ACHIEVE THIN WALLED BODIES

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

## ABSTRACT

*This paper aims at presenting a comparative study of the "Shell" command / control which generates bodies with thin walls or some equivalent commands to be found in the following design software packages: Mechanical Desktop 6 or NX and Solid Edge 7.5 v.20. In other words all these variants of the basic command are comparatively approached, as they are likely to produce cavities and their features are particularly highlighted.*

KEYWORDS: CAD, Mechanical Desktop 6, NX 7.5, Solid Edge v.20

## 1. GENERAL ON COMMANDS FOR THE GENERATION OF THIN WALLED BODIES

Getting thin walled bodies appeared as a necessity with the development of three-dimensional design software, which has led to such bodies, based on solid bodies, by imposing a constant wall thickness on the outer surface of a concave or convex body.

This new facility to work in 3D space should be appreciated accordingly in that it allows a shorter time for modelling the parts due to geometric calculations on all intersections of surfaces performed by the software.

It should be noted that what makes such a control can be achieved with traditional commands followed by the set of Boolean commands that perform reduction operations between 3D geometric bodies. Also another overwhelming advantage of these commands is that they allow very easily to make for changes to the wall thickness. Last but not least the "Shell" command category allows imposition of different thickness at each level of the outer sides of the body, from which everything starts to obtain a thin walled body.

## 2. STUDY OF "SHELL" COMMAND IN THE MECHANICAL DESKTOP 6

Launching "shell" command can be done in two ways, one as in Figure 1, more precisely in the pull down Part / Placed Features / Shell and the second from the second short menu, installed between the browser and the modelling space. The command is inactive in case of geometric impossibility. In other words, in order to launch one of the two ways mentioned above, it should be done, in an earlier stage, concave or convex body able to meet the principles of generating 3D entities of "Part" type. For the purpose of this paper it was chosen the situation of a prismatic body consisting of a parallelepiped with a square base that has a truncated pyramid on top. Figure 1 shows the 3D model of this body.

The advantage of the command studied under the Mechanical Desktop, vs the similar version of AutoCAD, consists in the possibility of imposing different wall thicknesses of the body subject to this editing command.

As shown in Figure 2, the command "Shell" allows to select one of the options for generating Inside / Outside / Mid-plane plus the option of excluding some faces from the

operation of generating thin walls (Add ...-Excluded Faces) or to restore the initial selection.

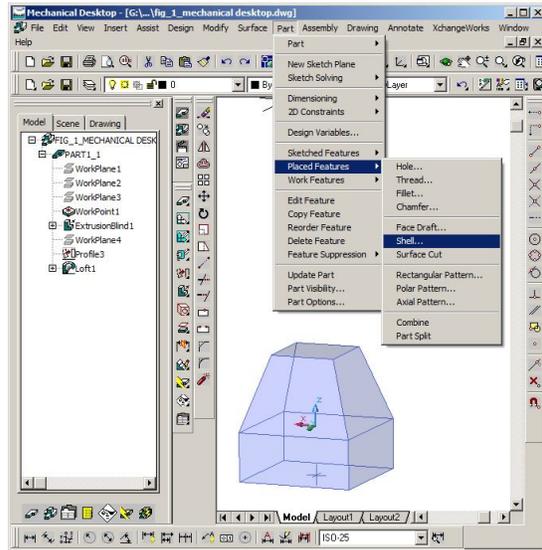


Fig. 1 Launching „Shell” command

These options regarded as a unit allow for thin walled bodies, showing or not open cavities outside.

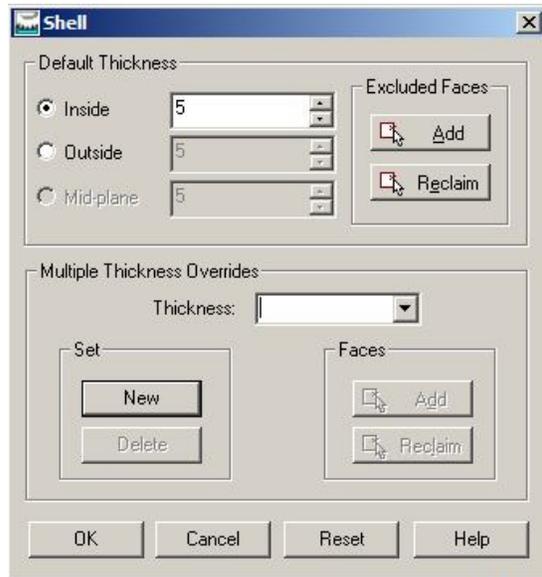


Fig. 2 Working window of "Shell" command

The lower part of the dialog box shown in Figure 2 allows for different wall thicknesses on different walls. Thus Figure 3 illustrates a body with thin walls where the following restrictions were imposed: the upper face is excluded from the walls thin generation, the wall thickness is 5 mm generally but there are exceptions to this rule, namely sidewalls of the truncated pyramid are 7 mm and the wall of the body base is 10 mm. In other words, the overall thickness is applied only to the side area of the base parallelepiped.

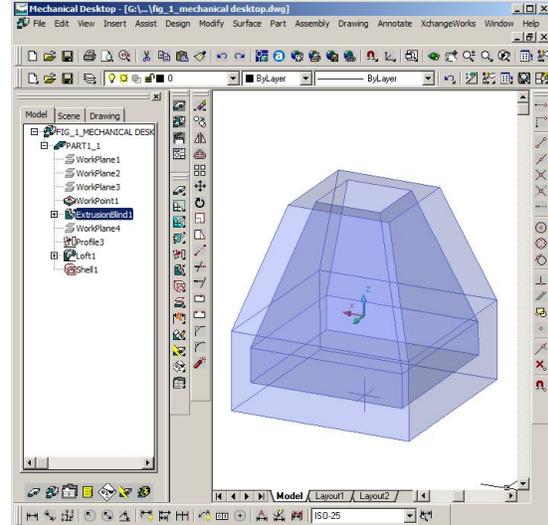


Fig. 3 The result of applying the command "Shell"

The graphic and somehow spectacular results obtained by applying the command "shell" of the Mechanical Desktop are shown in Figure 4, namely to obtain the 3D model of a pump equipped with a safety valve within a block boiler.

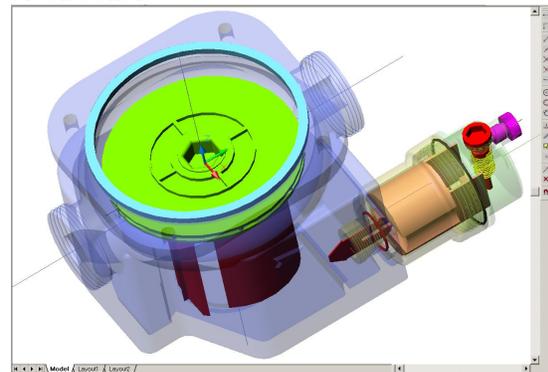


Fig. 4 Other results of „Shell”command

### 3. STUDY OF "SHELL" COMMAND FROM THE NX 7.5 SOFTWARE PACKAGE

The "Shell" command within NX 7.5 has an effect similar to the one achieved with Mechanical Desktop software but with some peculiarities. Launching this command is from the Toolbox shortcut called "Feature" which is shown partially in Figure 5.



Fig. 5 Shortcut of launching „Shell” command

As with Mechanical Desktop, the version of command "shell" of NX allows the imposition

of different thickness in the walls of the body to be achieved. Regarding the differences, we should mention that the version of command "Shell" from Mechanical Desktop has a higher performance vs NX as regards only the three options (Inside, Outside, Mid-plane) and not just two (inside, reverse direction) as with NX. On the other hand, the command studied in NX is superior by:

- ✓ Different thicknesses that are imposed on the walls of the piece can be viewed simultaneously in a unified list.
- ✓ It allows in the "Settings" section the choice by the designer of one of the following "Extend Tangent Face" or "Add shelf is at Tangent Edge".
- ✓ Allows setting in the "Preview" section so as to visualize the outcome before closing the command.

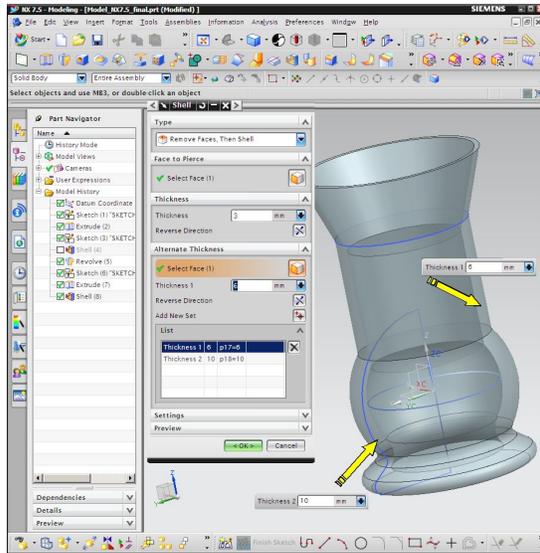


Fig. 6 Parameters of „Shell” command

It should be noted that the command "Shell" applied to both software studied is not to achieve the thickness discontinuities in the adjacent walls but different thickness.

It was also found that different thicknesses can not be applied on complex sections, obtained by the command "Revolve" that are not based on sketches made with B-spline curves or multiple arcs.

For this reason the recommendation is that those sections obtained by the command "Revolve" should have contours based on simple sketches made especially by few segments and arcs. Figure 7 shows a subset of the auxiliary equipment from an aerosol device, made with NX 7.5, containing landmarks using the command "Shell".

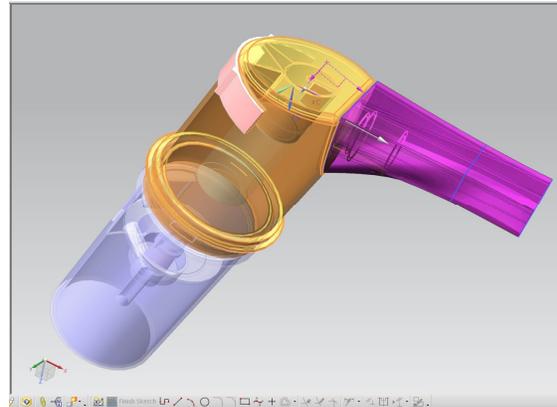


Fig. 7 Subassembly with items made by „Shell”

#### 4. STUDY OF THE "SHELL" CONTROL FROM SOLID EDGE V.20

The design software Solid Edge V20 has two commands / controls equivalent to the classical "Shell" control which is called "Thin Wall" and "Thin Region".

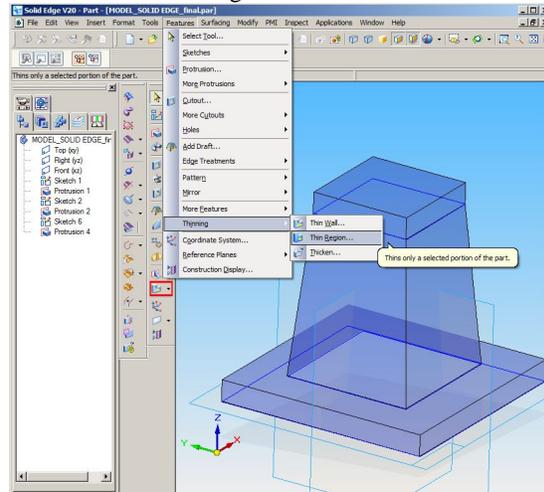
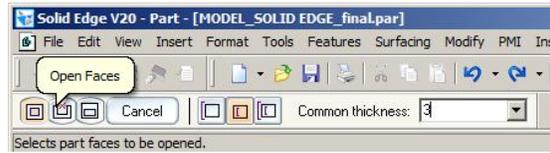


Fig.8 Launching "Thin Wall" and "Thin Region" controls

Differences between the two versions mentioned above are not radical, but the one which allows three-dimensional work provides more performance. Launching both orders can be made from the pull down "Features" as shown in Figure 8, or from the shortcut positioned between the "Edge Bar" and the 3D modelling space.

The essential difference between the two commands is that the first allows for the realization of thin walled bodies starting from the entire 3D feature of "Part", while the second allows for the selection of 3D regions from the part achieved, followed by completion of steps similar to the first situation.

Basically, the steps to follow in case of control "Thin Wall" are shown in Figure 9 and detailed below:



- ✓ Step 1 – first the general wall thickness (5 mm) is indicated.
- ✓ Step 2 - Front facet (without weight) is indicated, in this case, is the top facet of the work piece.
- ✓ Step 3 - different thicknesses are required on the different faces of the same parts (thickness 3 mm from the base of the piece).

The result obtained for the above mentioned values is shown in Figure 10.

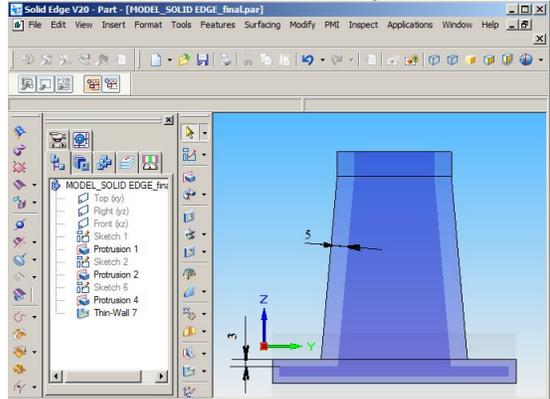


Fig. 10 Result of “Thin Wall” control  
This variant of – „Thin Wall” - control features 3 application variants namely: Inside, Outside and Symmetrical.

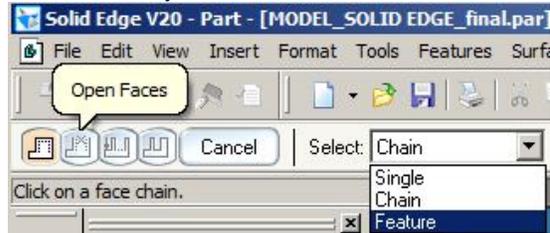


Fig. 11 Dialogue specific to “Thin Region” control

Steps to be taken with "Thin Region" are shown in Figure 11 and detailed below:

- ✓ Step 1 - select 3D regions in the "Feature" and set in this case a 5 mm thickness;
- ✓ Step 2 - the open face (no thickness), in this case, is the top facet of the work piece;
- ✓ Step 3 - indicate to the most bottom face that will act as "capping Faces" and it requires a zero value in the window "Offset". It should be noted that in the previous version, zero was not allowed by the software.

The result obtained for the numerical values given above is shown in Figure 12.

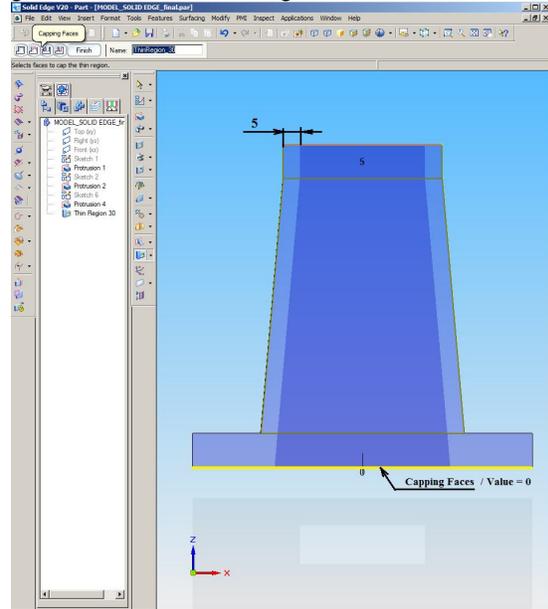


Fig. 12 The result of the command "Thin Region".

## 5. CONCLUSIONS AND FUTURE WORK

The main conclusion of this work is that each software in part manages to generate any body with thin walls. If the first part of the paper shows the Mechanical Desktop NX superiority, in the second part things are different in that Solid Edge NX is more advanced than the Shell command as the output of "Thin Region" control cannot be achieved in NX only with the command "Shell". Subsequently this command is to be applied a „Move Face" control to reach the situation presented in Figure 12.

In the future the author intends to expand the study to software: Inventor 2013 and Solid Works v. 2008.

## REFERENCES

[1] **Goanță A.M.** – „ *Comparative Study Of "Revolve" Command In The Average-Class Design Software Taught In The Higher Education*”. Analele de inginerie mecanica ale Facultății de Inginerie din Brăila, 2012 Issue vol. 2, ISSN 1224-5615, <http://www.ann.ugal.ro/im/> . pp. 9-12.

[2] **Haraga G., Ghelase D., Daschievici L.,** “*Geometrical shapes with CAD systems*”, The Annals of “Dunarea de Jos” University of Galati, Fascicle XIV, Mechanical Engineering, CNCSIS code 220, „B+”, Indexed Journal BDI-CSA (Cambridge Scientific Abstracts) ISSN 1224-5615, pp. 59-62, 2008, <http://www.ann.ugal.ro/im/2008.htm>