

CONSIDERATIONS ON 2D CONSTRAINTS FOR DRAWINGS MADE WITH EXISTING DESIGN SOFTWARE

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ABSTRACT

This paper aims at present the author's personal reasons on the set of dimensional constraints existing in each design software, that are designed to achieve certain parametric sketches. In general, constrained sketches, whatever sided they receive as value-dimensional constraints; remain permanently in the same family of geometric shapes. The study was conducted on the following design software: Mechanical Desktop 6 or NX 7.5 and Solid Edge v.20.

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

1. GENERALITIES ON DIMENSIONAL OR GEOMETRIC SHAPE CONSTRAINTS

The early appearance of design software involves only working with 2D drawings. Later, due to hardware development there was a transition to 3D design that actually was the first step in the development of three-dimensional design as editing tools generating bodies were less efficient, which was a real drawback at the moment. At this point almost all design software works in three dimensional environments [1] and leads to overall design or execution automatically or based on dialogues with extremely friendly software. The strength of this software is the fact that the modification of the solid body or assembly involves quick updating of the related design.

It should be noted that achieving extremely rapid changes in the 3D is due to the fact that solids are based on parametric sketches defining geometrically constrained contours. In other words, if the designer modifies a size on a certain parameterized drawing, the related shape changes its size but the shape remains similar to the original, thanks to the dimensional constraints imposed at the outline. Generally, each software design transmits to the

user a specific message on the command line or modelling space in that the achieved sketch is totally constrained. This message certifies that from this time on, any change to the size of sketches, it will keep its shape and remain all the time in the same family of geometric shapes.

2. STUDY OF 2D CONSTRAINTS MECHANICAL DESKTOP 6

The set of constraints that can be applied to 2D parametric sketches in the Mechanical Desktop is shown in Figure 1 and includes the following:

- ✓ Tangent constraints;
- ✓ Concentricity constraints;
- ✓ Co linearity constraints;
- ✓ Parallelism constraints;
- ✓ Perpendicular constraints;
- ✓ Constraints of horizontality or verticality;
- ✓ Constraint of "Project" type. This allows for the setting of a line or circle or points of construction.
- ✓ Constraints "Join". This allows connecting points of the same profile.
- ✓ Constraint "X Value" and that "Y Value". This allows fixing a value common to

abscissa of type X, type Y ordinates respectively, of arcs or circles of the same profile.

- ✓ Constraint „Radius”;
- ✓ Constraint „Equal”;
- ✓ Constraint „Mirror”;
- ✓ Constraint „Fix”.

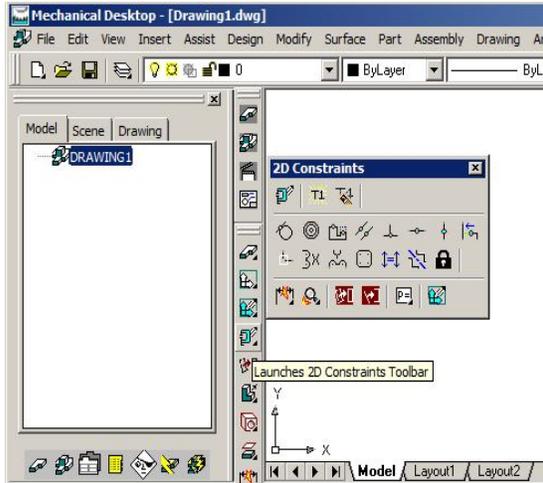


Fig. 1 Toolbar „2D Constraints”

The command set "2D Constraints" contains two commands for sizes: "Power Dimensioning" and "Power Edit" and two commands for either adding geometry to existing sketches or determining the necessary number of constraints to be further imposed, so that the resulting drawing is totally constrained.

The last button in the "2D Constraints" sets how to write the sizes on the sketch, enabling the designer to display them in the form of numerical value, imposed numeric parameter size or parameter of specific name and assigning specific numerical value.

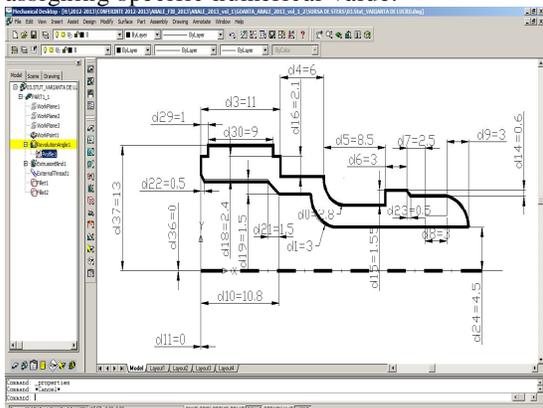


Fig. 2 Example of parameterized size drawing

Figure 2 presents a geometrically and dimensionally constrained sketch which with Mechanical Desktop is called *Profile*, where sizes are written as imposed numerical parameters. The result obtained by rotating the sketch in Figure 2 around the axis drawn as

point thin line is illustrated in figure 3. The end result required an additional command type "Extrude" in variant "CUT", a threading operation and two 3D connecting commands.

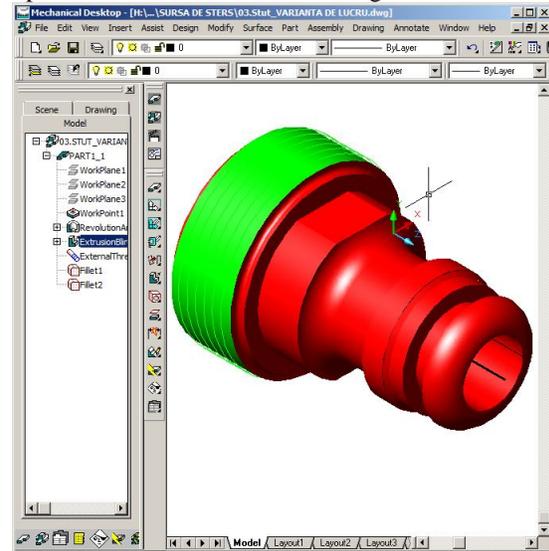


Fig. 3 The final result of command "Revolve”.

3. STUDY OF SOLID EDGE V.20 2D CONSTRAINTS

The set of 2D constraints that can be applied to 2D drawings made with Solid Edge v.20 [2] is shown in Figure 4 and contains the following:

- ✓ Connect - connects a point on a geometric element to another element or series of geometric elements.
- ✓ Concentric - requires concentricity for two or more circles or arcs.
- ✓ Horizontal / Vertical - constrains two points or two segments to find vertically or horizontally;
- ✓ Collinear - makes two lines be collinear;
- ✓ Parallel Relationship - constrains two segments to become parallel. The first selected element changes its orientation and becomes parallel to the second one.
- ✓ Perpendicular - two segments are constrained to become perpendicular. The first selected element is at right angles to the latter.
- ✓ Lock - locks the size or the selected item not allowing any amendments thereto.
- ✓ Rigid Set - imposes rigidity on selected items, in that it preserves the relative position between them.
- ✓ Tangent - requires tangent between selected elements;
- ✓ Equal - requires equal at item or size level;

- ✓ Symmetric Relationship – imposes symmetry of two geometric elements relative to the axis of symmetry;
- ✓ Symmetry Axis - requires a selected segment to become the axis of symmetry.

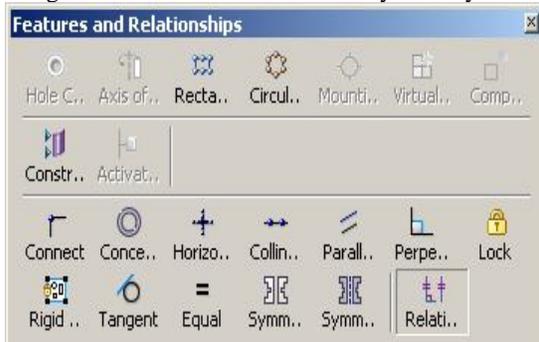


Fig. 4 2D constraints made by Solid Edge

A first difference found between Mechanical Desktop and Solid Edge is the direct achievement of the parameterized sketch in Solid Edge without going through an initial stage of drawing followed by a further transformation of the design, in a profile-type sketch. Also it can be seen easily that Mechanical Desktop has several constraints are compared to Solid Edge, namely 15 versus 12. However, the sketch achievement and constraint is much easier compared to Mechanical Desktop Solid Edge. I mention that the last option of constraint type in Solid Edge, called "Relationship Handles", actually makes quick view or hide of all two dimensional constraints.

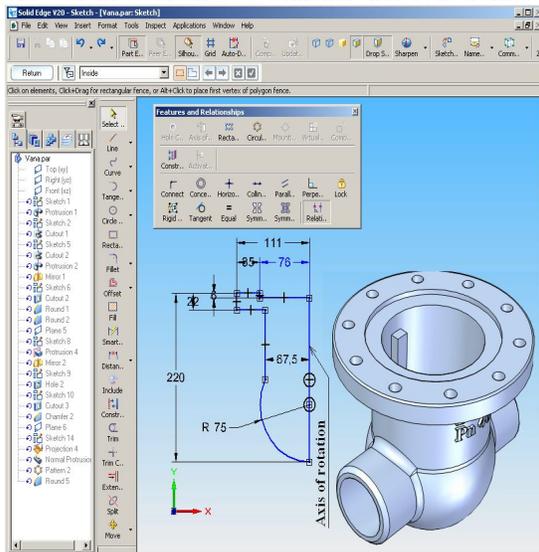


Fig. 5 Sized and constrained sketch

Particularly interesting is the "Rigid Set" option which makes rigid elements, creating a set whose geometry behaves as a single geometric entity [3]. In Figure 5 is shown a sketch quoted and 2D constrained which by rotation around the axis marked on the drawing

generates a large part of the three-dimensional geometry of the valve body viewed in the same figures. In this figure it can be recognized the symbols of some common constraints such as *Vertical, Horizontal, Connect, Symmetry Axis*. Also as an element of superiority of Solid Edge vs Mechanical Desktop it should be noted the former's dynamic editing capability of sizes associated with there selected drawings that are made with simultaneous visualization of both the sketch and the 3D model. Such dynamic editing of the sketch is shown in Figure 6.

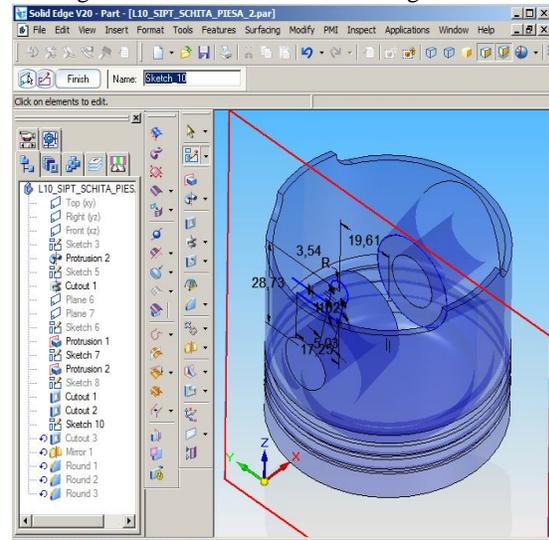


Fig. 6 Dynamic editing of the sketch

4. STUDY OF 2D NX 7.5 CONSTRAINTS

The design software NX 7.5, due to the fact that it is produced by the same company that produces Solid Edge, namely Siemens in Germany, is optimized in terms of 2D constraints as compared to Mechanical Desktop. All self-constraints allowed are viewed in Figure 7.

As one can easily find, the NX constraints resemble those of Solid Edge, but are viewed in a separate window, except that there is a particular constraint, which requires constant length for the selected items. The particularity of NX consists of the following:

- ✓ Selection of a constraint to a geometric element first involves selection of that element, selecting by the mouse right button the contextual command "Add Constrains" and then choosing the desired constraint. The context menu is shown in Figure 8.
- ✓ Positioning the cursor on the selected item allows for the selection of different constraints. Thus to order the coincidence of two segments ends, their selection should be

done as close as possible to the ends to be selected. Otherwise the constraints list provided to the designer by the soft will not contain the constraint of "coincidences" type.

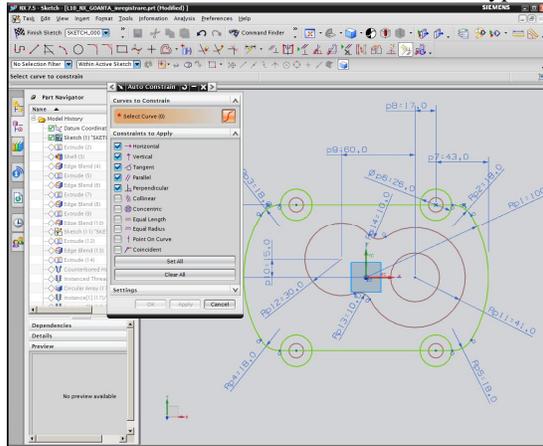


Fig. 7 Viewing the allowed self-constraints

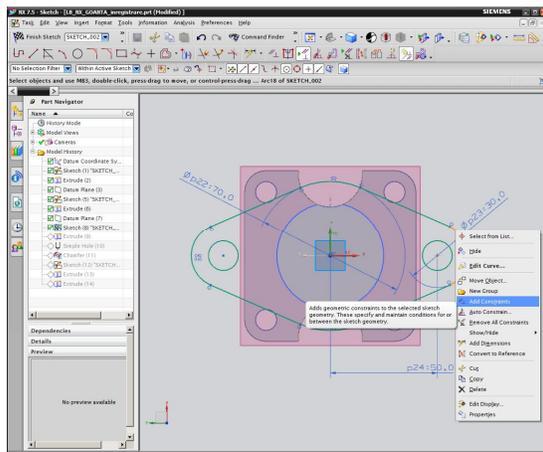


Fig. 8 Context menu to add constraints

✓ If accidentally the designer wants to impose a constraint geometrically impossible, the software sends a message to this effect and changes the default colour of the entities affected by the mistake in red.

✓ One of the indisputable advantages of NX consists of its ability to view a specific window as shown in Figure 9, the entire list of constraints built up to a point, which allows the designer to better manage them in terms of adding and removing some of them.

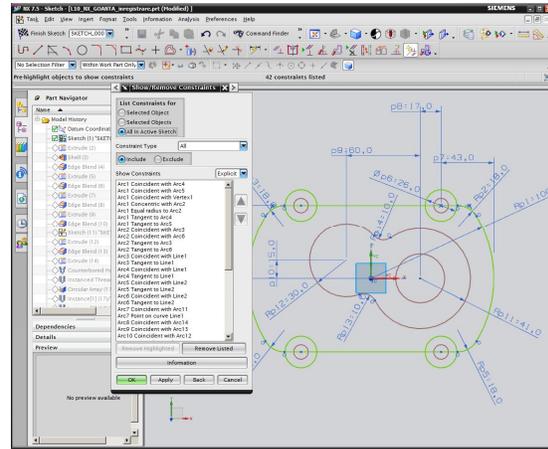


Fig. 9 Viewing the constraints list

5. CONCLUSIONS AND FUTURE WORK

The main conclusion of this work is that each soft succeeds with less or more effort in generating constrained parametric sketches from geometric and dimensional point of view. If the first part of the study showed the superiority of Solid Edge over Mechanical Desktop, in the second parts things change a little, in that Solid Edge is surpassed by NX due to better optimization of the context menus and necessary dialogues.

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

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