

Advanced 3D MCAD assembly enhancements illustrated with the SMART LAB STATION model, designed with the UGS Solid Edge V15 system

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SUMMARY

The paper presents topics connected with chosen brand new enhancements of associative assembly design, that are a part of the *UGS Solid Edge V15 3D MCAD* system. The applied example is an intelligent *3D* model of a laboratory station. A flexible dimensional management of already designed model is shown. Its effect is a parametric update of chosen assembly components, such as parts geometry, fasteners location (bolts, nuts, washers etc.) and hydraulic, pneumatic or electric system paths. The paper introduces application of so called *Systems Libraries* i.e. groups of parts already taught how to be automatically placed in the assembly and how to enforce necessary part modelling features. The way *2D* draft documents are also updated after any change of the assembly is presented.

Presented "*SMART LAB*" *3D* model and aforementioned brand new assembly design approach has been already applied in *Military Aviation Works No 2* in Bydgoszcz.

INTRODUCTION

Many versions of the same machine or device are often introduced and brought into practice at the same time. In most cases they are all variously applied at the consumer market.

Individual variants of the product have got their own application and differ from others in manner, values of dimensions, applied material or installed ready-made components i.e. engines, drivers, control and measurement systems etc.

Industrial design and manufacturing documents, both *2D* and *3D* are supposed to contain data and descriptions for a complete range of a company's products, that are available on the open consumer market.

Most companies in the mechanical design trade are equipped with modern numerical tools at the present moment. An important kind of aforementioned tools is the *MCAD*

(*Mechanical Computer Aided Design*) software, and *UGS Solid Edge* has been the leader among *MCAD mid-range* tools for a very long time. The reason *Solid Edge V15* is a very sophisticated software is an intuitive *3D User Interface* and a philosophy that enables creating *2D* draft documents totally on the basis of *3D* models.

Skilfully designed and prepared *3D* documents can be *flexible*. Beginning with the design of just one fully parametrical main (basis) model, it is possible to generate design documents for a complete range of a company's products that, for example, differs from each other in values of chosen dimensions. The purpose can be achieved with linking values of important dimensions with variables (parameters). The specific value of a variable corresponds with the given kind of a product variant. After attaching previously assumed values to all variables, the main model transforms into the chosen derivative one. That is why, parametrical *3D* document of the main model is an important design platform. This easily enables creating so-called *family of 3D documents* and then derivative models are relatives.

Parametrical *3D* designing can be a difficult task if the *MCAD* assembly file contains lots of components, including hydraulic and pneumatic tubing or electrical wiring.

The paper presents an example of a parametrical design in the case of a laboratory station "*SMART LAB*" and shows chosen advantages for a User of the *3D MCAD UGS Solid Edge V15* system.

PARAMETRICAL 3D ASSEMBLY

Parametrical *3D* model of a "*SMART LAB*" laboratory station has been designed in the *Assembly* environment of the *UGS Solid Edge V15* software. The model consists first of all of aluminium *ITEM* profile parts, that make up a closed volume surrounded with panel elements made of an acrylic glass. Models of fasteners (including standard and original bolts, nuts, washers, etc.) and routes of hydraulic and pneumatic tubes are placed in the assembly, as well as electrical wires. There is the *3D* main model of the "*SMART LAB*" shown on the Figure 1, and the manner of *ITEM* profile parts assembly has been particularly presented.

The aforementioned *3D* model can be claimed as a relatively complex one. To establish parametrical relationships of the assembly, it is convenient to show only essential components. To do so, display configurations are necessary to be defined, recorded and applied. Results of chosen display configuration applications can be found on the Figure 2, especially ones that enable the display of *ITEM* profiles (a) and acrylic glass only (b).

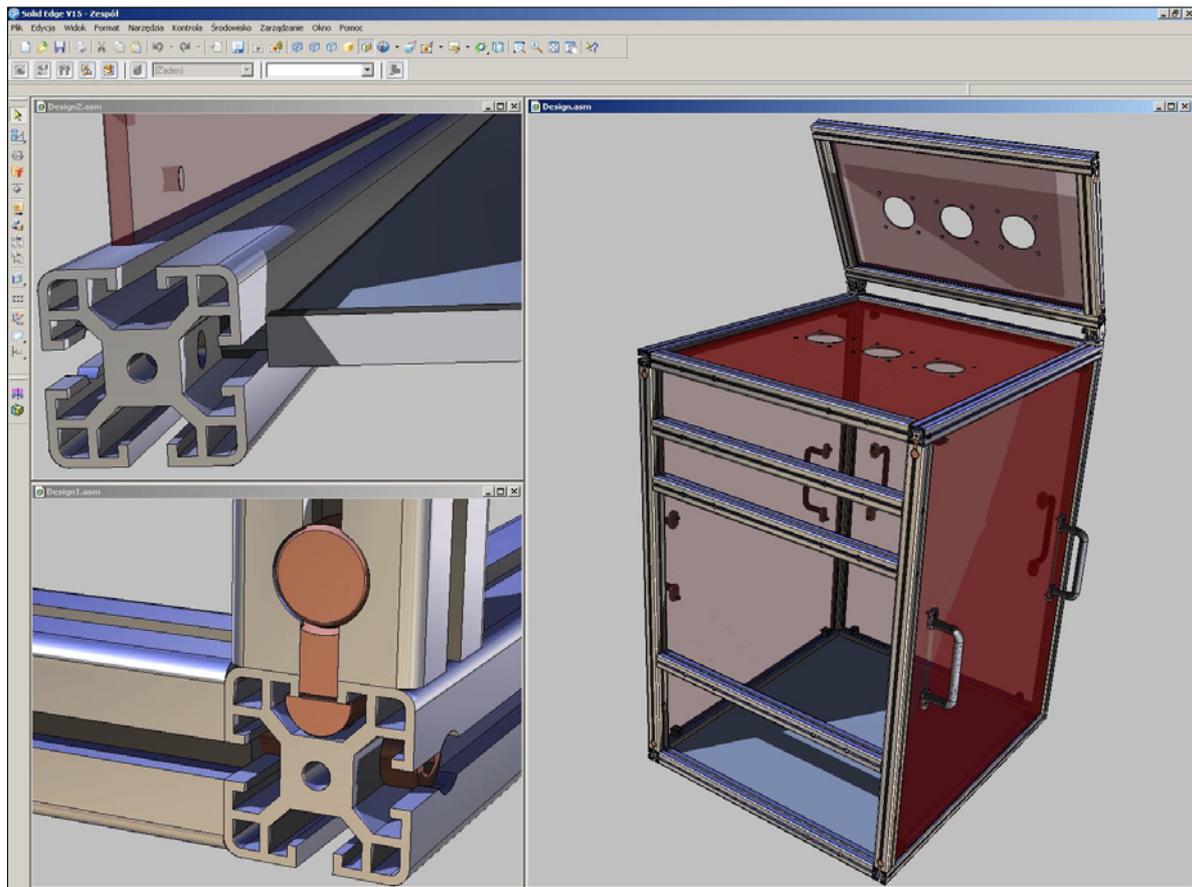


Fig. 1. The main model of the „SMART LAB” laboratory station, that consists of ITEM profiles

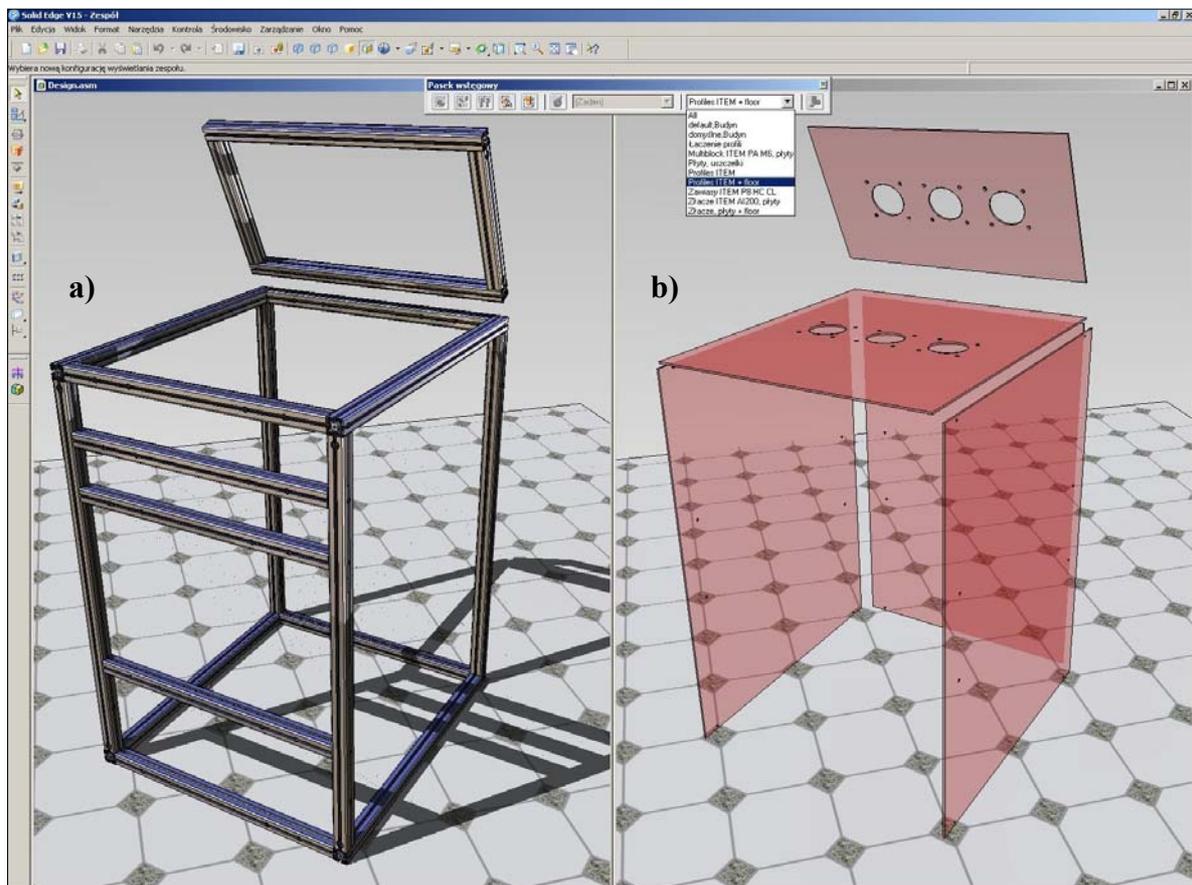


Fig. 2. Chosen assembly display configurations: a) “ITEM profiles ONLY”, b) “Acrylic glass panels ONLY”

The original 3D model of the laboratory station has been named the main one. Unique *Solid Edge hybrid 2D/3D assembly approach* has been applied. As its effect, the assembly geometry can be easily managed by the geometry of a simple 2D sketch layout. In the case of the “*SMART LAB*”, values of assembly sketches dimensions influent total width, length and height of the model, as shown on the Figure 3. Any change made to layout sketches geometry, forces necessary *ITEM* profile parts to lengthen or shorten their bodies. Aforementioned profile parts are called general ones. They are the most important parts of the assembly, it’s framework.

Geometrical relationships (so called *Inter-Part* ones) between sketch layout and the geometry of general parts, have been established with the *Variable Table* tool.

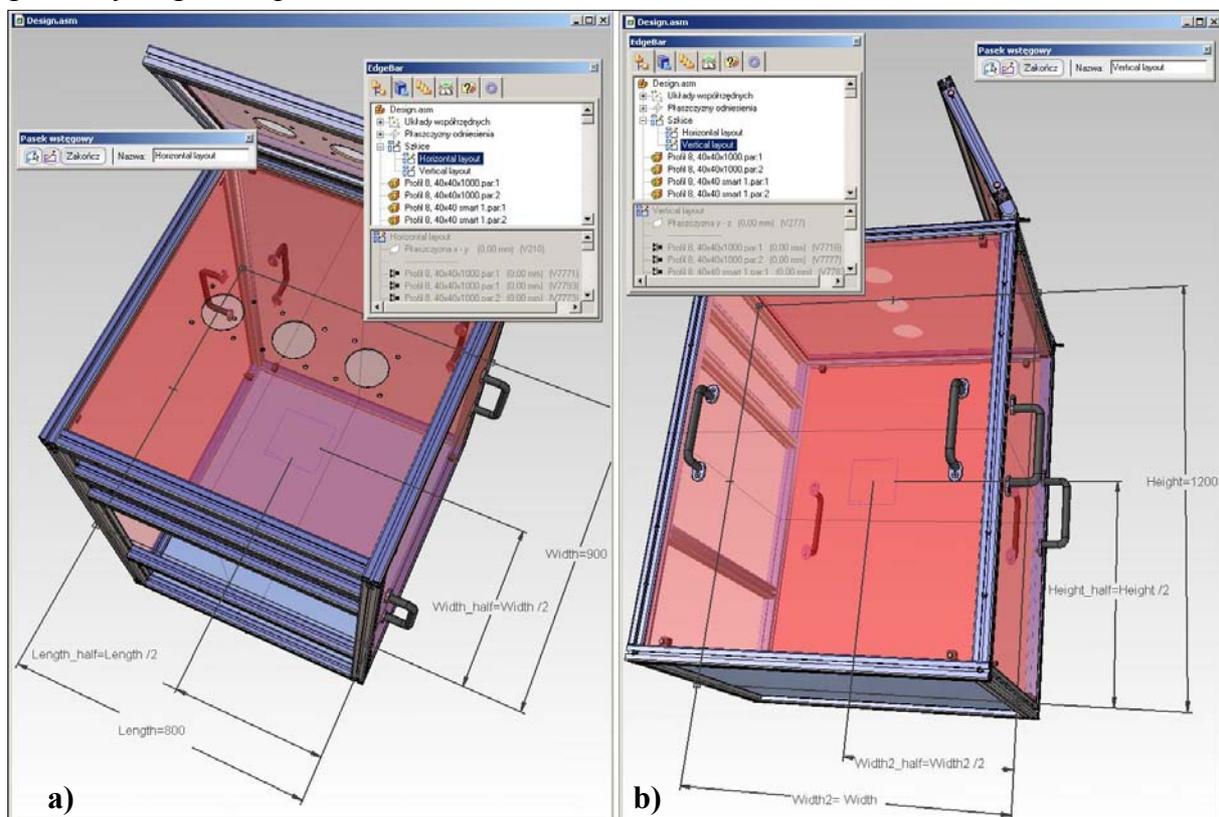


Fig. 3. Values of “*SMART LAB*” general parts dimensions depend on assembly sketch layout geometry: a) horizontal *X-Y* sketch, b) vertical *Y-Z* one

The geometry of associated parts (e.g. acrylic glass panels, handles, hinges etc.) is linked to general parts by copying a surface presence of *ITEM* profile parts into their *.par* files with the *Inter-Part Copy* tool. As a result, the bodies of so-called *Parent* geometry are constantly monitored. This allows models of associated parts to be created and placed into the assembly absolutely correctly. The process of inserting *Inter-Part* copies during designing one of the acrylic glass panel models can be seen on the Figure 4. The *Inter-Part Manager* dialog box can be also noticed.

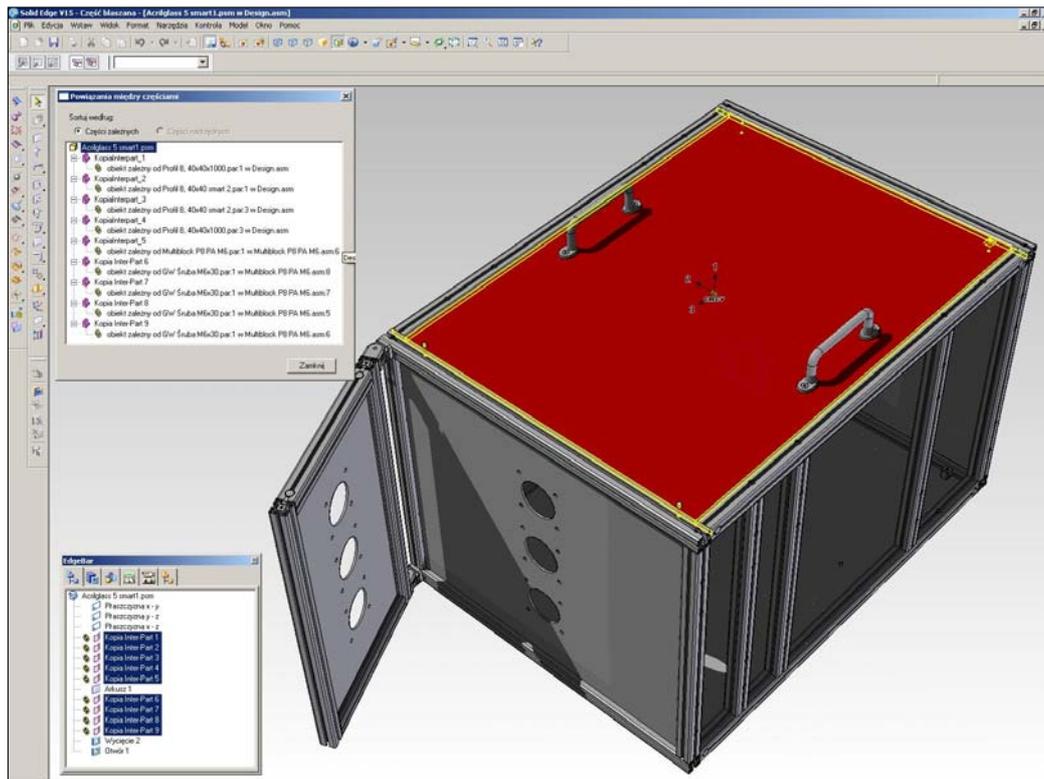


Fig. 4. Establishing and verifying of surfacing *Inter-Part* copies of general parts geometry is essential to properly design associative parts, e.g. acrylic glass panels

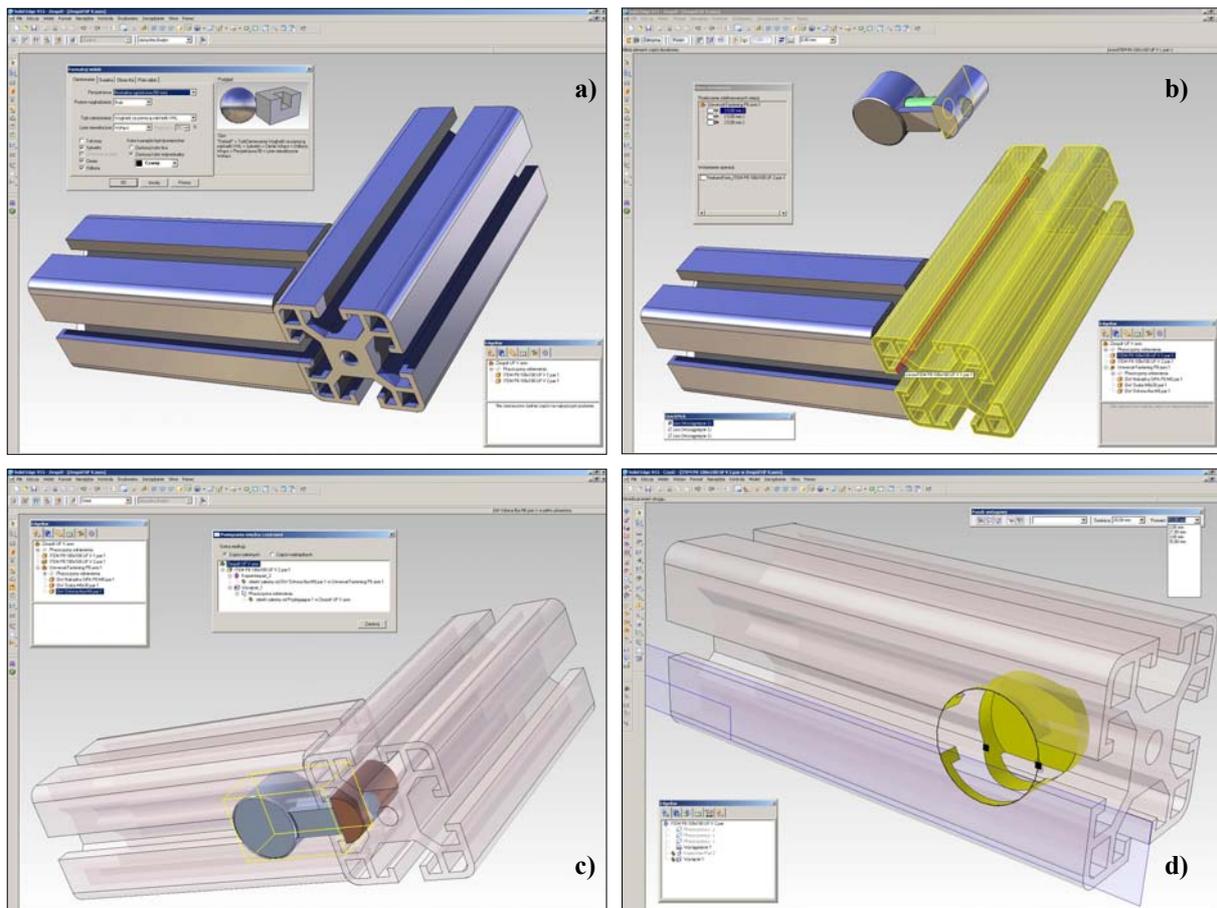


Fig. 5. Placing and applying the *Systems Library* of the *ITEM* fastener: a) preparing the assembly, b) semiautomatic placement, c) forcing body features in chosen assembly components, d) the *ITEM* profile part modified with the additional associative feature

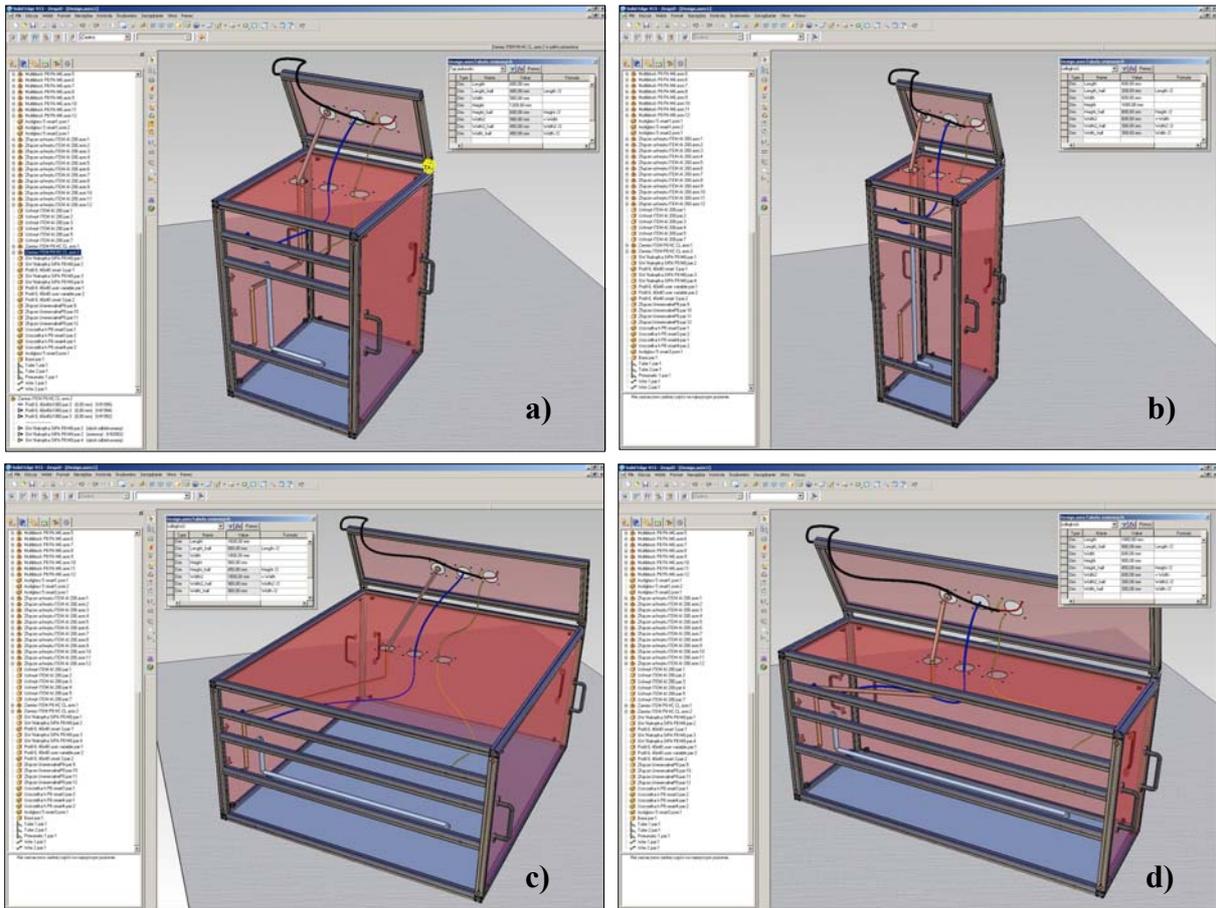


Fig. 6. Examples of derivative 3D models (b, c, d), created on the parametric main model (a) transformation

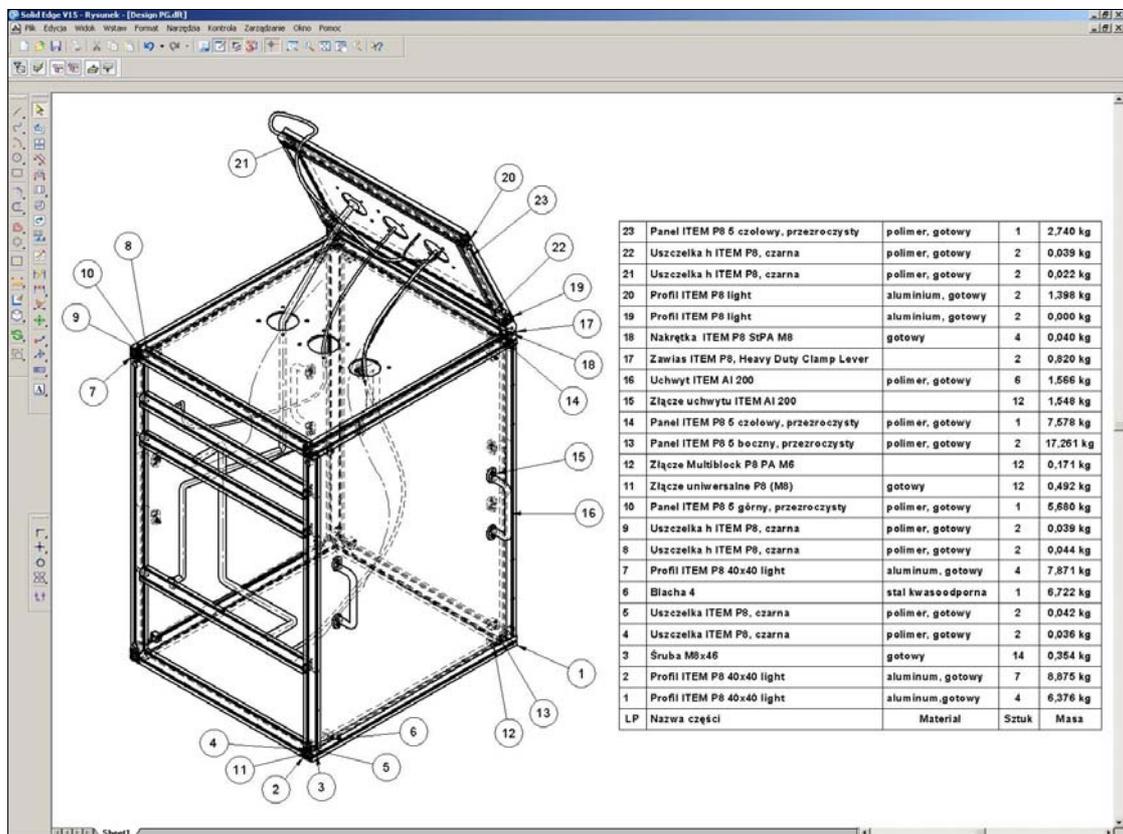


Fig. 7. The draft 2D document, based on the 3D geometry, can be automatically updated while the assembly structure or dimensions change

To make the “*SMART LAB*” design task much easier and allow the User to make the job done faster, improved models of standard bolts and *ITEM* fasteners have been created. The refinement process effect is that fasteners files store additional data, connected with such an information: kinds and values of relationships, requested to position the fastener in the assembly and definitions of associative features, that will occur in chosen assembly components, while the fastener is fully positioned.

Files of fasteners, after such a data improvement can be called a *Systems Library*. On the Figure 5, there is the assembly that consists of a pair of *ITEM* profile parts (a) and the process of placing the *Systems Library* fastener file in the assembly (b) shown. The final result of such a placement, the associative feature, can be spotted on the Figure 5.c, and its zoom within the context of the assembly – on Figure 5.d.

The geometry progress of the “*SMART LAB*” parametric main model can be a result of a variable value modification that takes place within the *Variable Table*. After defining new values of chosen variable parameters, the *3D* main model begins its transformation into such a requested derivative one. The *3D* main model and examples of *3D* derivative ones are shown on the Figure 6. All routes and body parts of hydraulic and pneumatic tubes are updated at once as well as electric wire models.

Classic *2D* documents of the “*SMART LAB*” are created in the *Solid Edge Draft* environment, absolutely automatically on the basis of the *3D* assembly model. Draft data can also be *flexible*, because the geometric progress of the *3D* model enables the update process of the *2D* drawings, their dimension, parts lists, callouts etc. However, the update can be optionally suppressed by the User anytime. The piece of the *2D* draft document of the “*SMART LAB*”, the main isometric drawing, the automatically filled up parts list and balloon callouts are shown on the Figure 7.

CONCLUSIONS

Geometrically parametrical complex *3D MCAD* model of the laboratory station “*SMART LAB*” has been successfully designed. Modern aluminium *ITEM* profiles parts are the part of the assembly. With the application of *hybrid 2D/3D assembly approach*, main values of *3D* model are linked to the geometry of *2D* sketch layouts, and that is why every single transformation of *3D* “*SMART LAB*” main model requires little User interactions. *User Interface* only activities, connected with the main model geometric progress, occur in the spreadsheet of the *Variable Table* tool.

Creating surface presences of general *ITEM* profiles in files of associative parts (acrylic glass panels, fasteners, hinges etc.) enable immediate update of general and associative parts if any change in *Variable Table* takes place.

So, the complex 3D assembly model has been created, and its transformation from the main model into any derivative model is intuitive, easy and quick.

The application of data improved assembly files (*Systems Libraries*) in the case of *ITEM* fastener or any other similar elements is one of many recommended ways to fasten the design process within *UGS Solid Edge V15 Assembly* environment and make all User activities just pleasant.

Flexible 3D and 2D documents enable the designer to work hardly only once, just while creating the main 3D model. The design of every single derivative model of the product is unnecessary, every single document for the derivative model updates automatically.

The „*SMART LAB*” 3D flexible model has been tested and approved by the *Design Department of Military Aviation Works No 2* in Bydgoszcz, as well as aforementioned and described tools, that make the 3D complex design process faster and more efficient.

LITERATURE

- [1] Kazimierzak G.: Solid Edge 8/9. Helion, Gliwice 2001.
- [2] CDR catalogue of *ITEM* aluminium profiles – *ITEM MB 2004*

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