

WORKFLOWS USED IN DESIGN OF THE DECORATIVE ELEMENTS FROM A GARDEN

FLUXURI DE LUCRU UTILIZATE ÎN PROIECTAREA ELEMENTELOR DECORATIVE DINTR-O GRĂDINĂ

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Abstract. *When the computer program Inventor is used in order to design decorative and non-decorative elements from a garden, some workflows can be used and, is very useful to be known which workflow is properly in the given case. Starting from this, the authors made a comparative study, explained bellow, between these workflows, analyzing, step by step, each of them. Following this study, they arrived to some conclusions and recommendations, presented in the end of this paper, which are useful to follow in the case that is necessary to be chosen one workflow or other.*

Key words: workflows, assemblies, Inventor

Rezumat. *Atunci când pentru proiectarea elementelor decorative și non-decorative dintr-o grădină este folosit programul de calcul Inventor, pot fi utilizate anumite fluxuri de lucru și este foarte util să se știe care este fluxul de lucru corespunzător în cazul dat. Pornind de la aceasta, autorii au făcut un studiu comparativ, explicat mai jos, între aceste fluxuri de lucru, analizând, pas cu pas, fiecare dintre ele. În urma acestui studiu, ei au ajuns la câteva concluzii și recomandări prezentate în finalul acestei lucrări, care sunt utile pentru a fi urmate în cazul în care este necesar să se aleagă un flux de lucru sau altul.*

Cuvinte cheie: fluxuri de lucru, ansamble, Inventor

INTRODUCTION

The Autodesk Inventor software may be used for the design of the decorative and non-decorative elements from a garden. There are, at least, three good reasons to use Autodesk Inventor for such type of tasks. The first reason, is for the fact that the elements which are made from timber can be easily designed into files with the extension "ipt", meaning in files type that are named "part". So, any element that is made from timber may have any shape wanted by the designer and, during the design process, if it is necessary, he can be modified whenever the engineer wants. More than that the Autodesk Inventor offers even the necessary resources to represent and colour the element which are designed, at a certain time, according to the type of wood which will be used to obtain him (Tickoo, 2015; Waguespack, 2014). For example, the Material Library of this software gives the possibility to represents and colour the element, in the case of using of the next types of wood: birch, cherry, maple, oak and walnut (fig. 1).

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Fig. 1 The types of woods texture and colour

The second reason is related to the capacity of the Autodesk Inventor program, to generate and use so called iParts. These special parts are different from the other ones "in that they are essentially table-driven part factories" (Waguespack, 2014). Each iPart generates individually derived that are not editable. When an iPart is inserted into an assembly, a dialog box appears and the user can choose, from the table showed, a variation of the original part (Waguespack, 2014). So, is very easy to be modified the dimensions and even the aspect of a final product, of an assembly in fact, when iParts are available.

The third reason deals with the fact that Autodesk Inventor offers the possibility to the users, to insert, from so called Content Center, predefined volumes having different shapes in section, such as: rectangle, trapeze and so on. These special volumes constitute a great advantage when, in the design process, the time comes to design tenons on the specified parts (Waguespack, 2014)

In addition, it could be discussed other aspects like the using of some add-ons such as Woodwork for Inventor which transforms the Autodesk Inventor in a very powerful tool whose purpose is to offer the possibility to the engineers to easily design complex furniture from different materials, (Widom, 2013; Autodesk Inventor 2016 Learn by doing, 2015). But, an add-on like this involves additional costs and is warranted only in case that the majority of orders are original and need to be designed from scratch.

When the methodology of elaboration of a category of assemblies, by using the Autodesk Inventor software, is discussed it is mandatory to be established, among other, which workflow is better to be used. There are three categories of workflows: Bottom-Up (BU), Top-Down (TD) and Middle-Out (MO) (Tickoo, 2015). Therefore, the authors of this paper, made a study to establish which one of these workflows is better to be used when decorative and non-decorative elements from a garden are designed.

MATERIAL AND METHOD

For this comparative study it was chosen, a very simple element, a basket for garbage. The parts in his composition are: the basket-base, the lath, the iron ring and a sub-assembly make from a bolt, a nut and a washer (fig. 2). This element contain two types of assembling: tenon - mortise and bolt - washer - nut which are the most common joints which are meet in the case of the decorative and non-decorative elements from a garden (fig. 3).

First was tested the Bottom-Up method. Each component was generated in separated file, like part. The shape and the dimension of each part were carefully designed. Then was open an assembly file and each part was inserted using the

Place function.

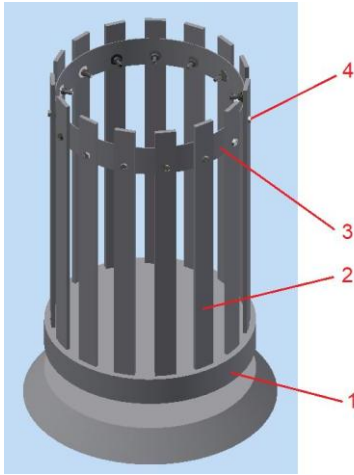


Fig. 2 The basket for garbage, 1 – basket base, 2 – lath, 3 – iron ring, 4 – bolt, washer, nut

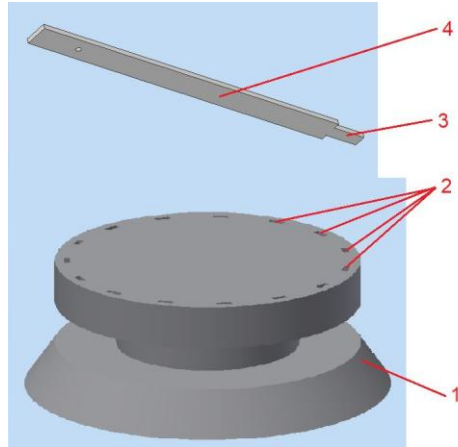


Fig. 3 The tenon-mortise joint, 1 – basket base, 2 – mortise, 3 – tenon, 4 – lath

The use of constraints was compulsory during the assembly creation (Hansen, 2017; Autodesk Inventor 2016 Learn by doing, 2015) Therefore, in the case of assembling tenon - mortise it was necessary to be identify three constraints, two of them are the *mate* type and one is the *flush* type (fig. 4). In order to place the ring to his place and to put him in a correct position in relation to the holes, it was necessary only two constraints, both are the *mate* type (fig. 5).

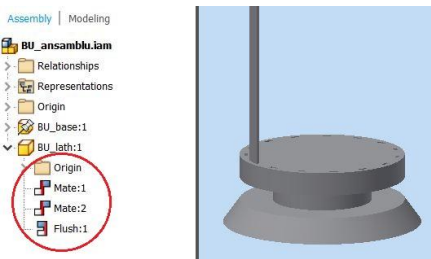


Fig. 4 The assembling tenon - mortise requires three constraints

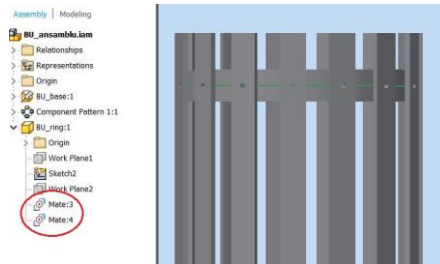


Fig. 5 The correct positioning of the ring requires two constraints

The Top-Down workflow was tested second. In an assembly file the base of the basket was first build. Then, by using the Create function were designed, one at time, the lath and the ring. During the building of the base, the dimensions of the mortise were established whit great care. The building of the lath started from that section that was to play the role of the tenon. The tenon was designed directly, in the right position, in mortise and after that the rest of the lath was build. During this process the computer program automatically determined only two constraints, of the *flush* type (fig. 6). The design of the ring imposed the use of two auxiliary planes and, from this

reason the number of constraints went up to five (fig. 7) but all of these were automatically established by the Autodesk Inventor.

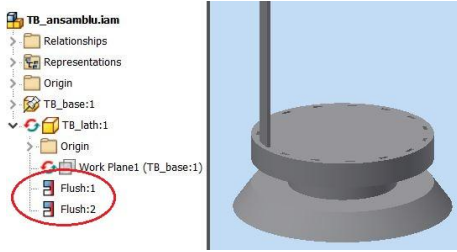


Fig. 6 The Inventor automatically determined two constraints

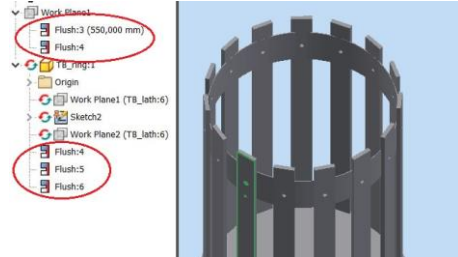


Fig. 7 The Inventor automatically determined five constraints

In the third step the Middle-Out workflow was tested. The base and the lath were built using the Top-Down workflow and then, by the help of the function Place was added the ring, basically, the ring was inserted in the drawing, so it can be said that was used the Bottom-Up workflow. The using of this workflow reveals the same work problems encountered in the first two workflows presented at the beginning.

Regardless of the workflow used until now, the bolt - washer - nut assembling was made in the same way and it no presented issues which worth to be analysed.

But another one workflow can be imagined. This fourth workflow assume to design all the parts of an assembly into a file with .ipt extension and, at the end of the process, this file will be transformed in an assembly file (with the .iam extension) and all the parts which were build earlier will be automatically saved in separated files with the .ipt extension (Widom, 2013; Borodovschij, 2017). Because the authors nowhere found in literature a name for this last workflow, they named him Part - Together (PT). This workflow was also analysed.

The first thing built was the base. The second was the lath. During the base part building process the mortises were not generated. When the lath was designed, a part of him was dimensioned in such way in that it can be used like a tenon. In that point the base part has not yet the holes that play role of the mortises (fig. 8). By the using of the Combine function the first mortise was obtained. Then, the rest of the mortises were generated with the Pattern function help (fig. 9). After that, were designed all the laths and the ring. During the all process, all the pieces were generated like distinct parts which were subsequently renamed, PT_Base, PT_lath and so on. At the end, the Make Components function was used, and the Inventor generated an assembly file and separated files for each component previous designed.

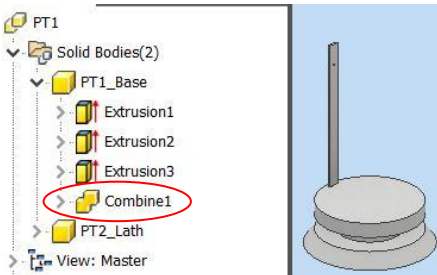


Fig. 8 The automatic generation of the mortise.

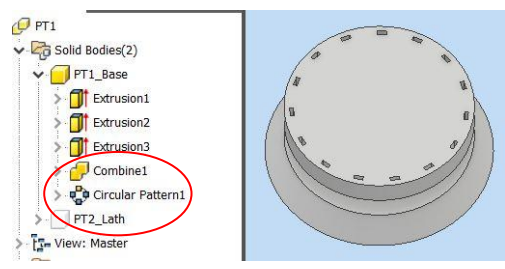


Fig. 9 The *Pattern* function was used in order to obtained the rest of mortises

RESULTS AND DISCUSSIONS

Analysing these workflows, the authors reached to the following results:

1. The BU workflow oblige the user to have a very clear mental image of the way that will look each part and their clear position of it in assembly. So, is mandatory to be done, a precise estimate of all dimensions, for all the parts. As consequence, the creation's effort of the image of every part and of the assembly is situated to a very high level. It can be said that the BU workflow is not intuitive and, in the same time, it is less flexible. Another disadvantage is the fact that each time a new part is inserted in the assembly it is necessary to determine the correct constraints and this operation take a lot of time. Of course, in this case, the use of the iParts can increase the level of flexibility.

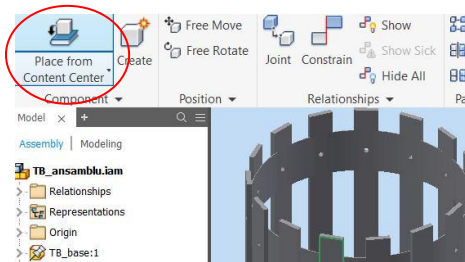


Fig. 10 The Content Center can be open and, from there, it is possible to be imported predefined parts.

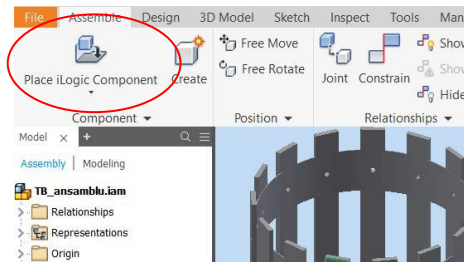


Fig. 11 It is possible to be used iParts.

2. The TD workflow is more intuitive than the BU workflow, because when a new part is created it easy to be observed the way in that this part can be fitted in the part which was created previous. So, when a part is designed, some dimensions may be established in an easy way, but for the rest of them, it is still necessary to be done a big effort. Here it is the advantage that the constraints are automatically determined by the Inventor software. Another advantage is the fact that it is possible to be used predefined parts having different shapes from Content Center (fig. 10). These parts, having so many shapes, can be used as tenons. But even in this situation is necessary to predict the shape and the dimensions of the mortises. Of course, the possibility to use iPart, like in BU workflow, could be considered like another advantage (fig. 11) A disadvantage is the fact that, in case which are used iParts, or parts anterior created, the software does not automatically determine the constraints. Another disadvantage is the fact that the Combine function doesn't work in this case.

3. The MO workflow does not bring any advantage compared to the TD workflow. Basically, is about the TD workflow when, at one moment, are inserted parts created before, predefined parts or iParts and this case was presented and analysed above.

4. The PT workflow is more intuitive than the TD workflow. The PT workflow offer not only the possibility to create a part starting from another part, by observing how they are fitting, but gives the possibility to generate some details of shape of a part by using the pair details from another part and this is possible because de Combine function may be used. In this workflow the iParts can't be used. This loss is not so important because when decorative and non-decorative elements from a garden are designed, the designers have to imagine a large variety of shapes and this make that factors like intuition and creativity to be more important than the possibility to the use of the parametric parts. Once a part was created, it is recommended to be renamed, because at the end of the creation's process, Inventor gives the possibility to save each part in a separate file by using the Make Components function. Once a part was created, it is recommended to be renamed, because at the end of the creation's process, Inventor gives the possibility to save each part in a separate file by using the Make Components function. If during of the element's design, the Pattern function is used, it is very important that this function to be set in such way in that each item of a pattern to be seen like a distinct part. Otherwise, when the Make Components function is used, the subassembly which resulting by the use of the Pattern function will be seen like a single part and will be generate a separate file with this subassembly.

CONCLUSIONS

1. In AutoDesk Inventor software, the PT workflow is the best when come about to project decorative and non-decorative elements from a garden, because is the most flexible and intuitive workflow between the known workflows.

2. In AutoDesk Inventor software, the DT workflow may be use to project decorative and non-decorative elements from a garden, but is less flexible than the PT workflow. In this case, there is the advantage that the iPart can be used.

3. In AutoDesk Inventor software, the BU and MO workflows are not recommended be used to project decorative and non-decorative elements from a garden.

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