3D MODELLING ASSISTED BY SOLIDWORKS SOFTWARE TO CREATE THE PRODUCT ”SCA CHAIR”

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Abstract

*This paper shows how easy it is to develop a 3D product that we want to launch in production line through the SolidWorks design software, which helps a lot when it comes to strength, functionality, raw material and production costs. It took about ten hours of actual work to make the complete assembly *SCA 3D*, which is very short time, and if the complete assembly is made using SolidWorks software it can be noticed that the assembly can be mounted, has mechanical strength as one can notice in the strength testing results when the chair is put to various forces or tensile tests. There are two very useful aspects in the design process, namely: if a change is made to an object part of an (sub)assembly, the assembly, respectively the subassembly will change, and the related technical drawings will be modified automatically and it will warn us if a mistake is made, and the second feature is that objects are physically assembled while taking constraints into consideration.*

Key words: SCA chair, design, SolidWorks software, functionality, chair testing

INTRODUCTION

SolidWorks is a computer-aided 3D geometric modelling software package for mechanical designers. It is a native, easy to learn and use-friendly Windows application, which allows users to model parts as individual entities, the modelling of part assemblies and to generate 2D documentation. (Vegra, 2019)

Usually, the modelling of a part begins with the drawing of a design and starting from this design the graphic base feature is generated, and then the other construction elements necessary to complete the model are added. Once a 3D model is made, it can be refined by adding, altering or rearranging the building blocks of which it is made. Developing complex models made in SolidWorks software mean using more than two functions or tools on a single model.

The SCA project came into being because the wood raw material became very expensive and certain projects became more expensive. The SCA chair is a concept that is designed in such a way that the wood material used to develop it is very easy to process, and the parts that make up this chair are designed in such a way that if certain dimensions are not respected in the case of certain parts they can be reused to another parts of the same chair.

MATERIAL AND METHOD

SCA is a folding chair designed for both camping and garden, but also for public use. It is easy to transport and takes up very little space. A professional-grade CAD software was used to carry out this project, namely SOLIDWORKS 2010 Professional, which is software that aided a lot in the design, testing and price calculation of this chair, as well as in the calculation of the necessary raw material and the required components to develop it.

In the first phase, the 3D model was created, which was assembled, checked and tested, after which the production and transport costs were also calculated using this software. After making these steps, the chair had to be modified in such a way that it was made at the lowest possible production costs without changing the structure or strength of the chair. By making the changes aforementioned it was possible to check and test the chair once again after the last changes.

In order to have a broader view of the assembly one can apply the "explode function" of the software, in which each component part is displaced in such a way that all the components can be seen.

Fig. 1. Explode SCA

In order to get as close to reality as possible when designing an assembly or a body in SolidWorks, we can make several studies regarding the strength of the body under certain conditions as described below:

– First, we will test the assembly at the force of 120 kg of pressure applied perpendicularly to the chair and backrest and with fixing from the lower end of the front and back chair legs, which comes on a flat surface (e.g. floor);
– In each study, the SolidWorks software helps us with a report for each element on which there were applied forces that generated changes on those elements, shaping the properties of the study within this paper.

RESULTS AND DISCUSSION

In the study on the chair pressure testing, the warning sensors provide great assistance when we are limited by the constraint by which an element in the chair body must not exceed certain values. In this case we place a sensor to warn us whenever this weight is exceeded and no matter how many bodies we have in the assembly, or if the bodies are not made of the same material, the sensor warn us whether the value is exceeded.

The tables below present all the conclusions of the study:

Table 1

All the conclusions of the study

Study name	**Study 1**
Analysis type	Static
Mesh Type:	Solid Mesh
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Thermal Effect:	Input Temperature
Zero strain temperature	298.000000
Units	Kelvin
Include fluid pressure effects from SolidWorks Flow Simulation	Off
Friction:	Off
Ignore clearance for surface contact	Off

The table below shows the units of measurement that were applied in the study:

Table 2

The units of measurement that were applied in the study

Unit system:	**SI**
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	rad/s
Stress/Pressure	N/m^2

The properties that were applied to each element in this study are showed in the tables below:

Table 3

The properties that were applied to each in this study

Material name:	**[SW]Fag**		
Description:	Material fag		
Material Source:			
Material Model Type:	Linear Elastic Isotropic		
Default Failure Criterion:	Unknown		
Application Data:	18.04.2021		
Property Name	**Value**	**Units**	**Value Type**
Elastic modulus	1.9e+012	N/m^2	Constant
Poisson's ratio	0.29	NA	Constant
Shear modulus	3e+008	N/m^2	Constant
Mass density	720	kg/m^3	Constant
Tensile strength	5	N/m^2	Constant
Compressive strength	5	N/m^2	Constant
Yield strength	2e+007	N/m^2	Constant
Thermal expansion coefficient	10	/Kelvin	Constant

The tables below show all the properties that were applied in this study to each element.

Table 4

All the properties that were applied in this study to each element

Material name:	[SW]Fag (2)
Description:	
Material Source:	
Material Model Type:	Linear Elastic Isotropic
Default Failure Criterion:	Unknown

The table below shows how the surfaces were configured and what tolerances were applied.

Table 5

The surfaces were configured and what tolerances were applied

Mesh Type:	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Smooth Surface:	On
Jacobian Check:	4 Points
Element Size:	11 mm
Tolerance:	0.55 mm
Quality:	High
Number of elements:	42859
Number of nodes:	82028
Time to complete mesh(hh;mm;ss):	00:00:10
Computer name:	DESKTOP-3LM6GFQ

CONCLUSIONS

In conclusion, the design of this chair has successfully passed all the endurance tests performed in SolidWorks software at 120 kgf according to the above test results and is ready to enter series production. The approximate deviation from reality is 10%, since the chair was tested by making use of exact forces and at an exact weight applied on the selected parts. The report results may include small deviations that fall within the tolerated limits due to the quality of the wood and the way it dries.

The optimization of the necessary raw material has been successfully achieved and it is no longer necessary to change the structure of the chair. It results that the technical documentation shows no errors and the parts are combined smoothly, so they can be successfully manufactured in the production workshops. In the series production this *SCA chair* can sustain a tolerance of ± 2 mm per gauge and ± 0,5 in the case of part processing operations.

The *SCA chair* has been designed with SolidWorks software and meets all standards in terms of strength, safety and quality. After testing this

chair at 120 kgf one can state that it is a solid chair, although it is a folding chair that is easy to transport and store. In brief, the *SCA chair* is much more efficient than any other model of folding chair because it has double folding and takes up very little space when folded.

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