FUNDAMENTAL TRAINING IN COMPUTER AIDED DESIGNING FOR PROFESSIONAL QUALIFICATION WITHIN THE FIELD OF GENERAL ENGINEERING

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***Abstract**: The present article offers an approach for more effective fundamental preparation for the work with CAD systems within the technical field of Basics in Construction. The approach is based on developed, and justified versions for practical application of fundamental computer aided designing of hydro mechanical elements and mechanical drives that are used throughout the training of students. Their 3D geometrical models present options for computer aided simulation, size analysis during designing of assembled units as well as options for training of master degree students in an optional field of Expert Systems. The obtained results are also useful for the purpose of better connections between general technical subjects and profiling subjects.*

Keywords: FUNDAMENTAL, COMPUTER, DESINGN, PROFESSIONAL QUALIFICATION, GENERAL ENGINEERING

1. Introduction

Tridimensional designing via CAD systems is based on fundamental preparation for generation of a model of information of a designed product. In order to create 3D geometrical model within a CAD environment as well as a simulation analysis throughout the process of its designing and training of students, one has to use developed releases from University origin. [1, 2, 3, 5].

One of the most important issues is the searching of collisions during the generation of an assembled unit as well as a verification of its functional performance throughout the process of construction. Also, a virtual analysis, a static analysis and a dynamic analysis [8,12] are required as they should concern technology during sizing of the assembled unit [7,11].

The necessity of acquisition of detailed skills and knowledge in the field of computer - aided designing throughout the engineering specialties is an argument for motivation of both teachers and students that they become more active. Whereas, it contributes to their integration in the European Education Programs for University - based training that corresponds to the credit system [14, 15].

The purpose of the present work is to establish an approach for more efficient, fundamental preparation for CAD system usage in the technical subject of 'Basics of construction'.

The main goals are as follows:
> Analyzing of hydro mechanical details and mechanical drives that are developed and practical through the process of training;
> A rationale of mechanical product versions for practical work in laboratories, curs task and examination of the students' skills and knowledge in the field of General Engineering;
> An analysis of the connection between technical and profiled subjects that involve computer -aided designing throughout the process of training.

2. An analysis of developed mechanical products

The performed analysis reviews the process of training of students from the professional qualification of 'General Engineering' which includes the following degrees: 'Bachelor' for 'Basics of construction'; 'Master' for 'Expert systems'. This proposition has been based on the accumulated experience and on the curricular process of development of 3D models and mechanical products. It also stems from the motivation of the students who study a technical subject that involves CAD systems throughout the process of designing. In relation to all these circumstances, two groups of mechanical products have been offered (Table 1).

Libraries for generation of assembled units of mechanical products have been developed on the basis of the already created geometrical models of the compound details [Fig. 1, 2, 3].

In order to create 3D geometrical models of a detail from a safety overflow valve (Fig.1) 'Step by Step' and in order to assemble the compound details of the designed valve, one has to use methodology of execution of a task in laboratory environment. An instance of simulation is to be performed as it must represent the behavior of the piston, namely 'Opening and closing' of the safety overflow valve [9, 10].

The pneumatic distributor (Fig.2) is to be used to the end of deciphering and detailed breaking up of the general drawing as well as for the purpose of execution of sketches of details and 'Pictorial shaded exploded assembly drawing' [10].

During recent years, the so-called 'competitive engineering' has been introduced as it requires collective work by teams of technical and non-technical specialists exchanging computer-based information [2, 6, 14]. It is important to use expert systems throughout the processes of automatization and designing[4].

Fig.3 represents an instance of a 3D model of a double stage planetary gearing which is to be studied throughout the Master degree training [13]. The double stage planetary gearing can be used for the purpose of establishment of creative solutions throughout the process of construction on the basis of expert systems.

3. Application of products for training

In order to choose versions of mechanical products, one has to take into consideration the curriculum, the scope of work and their respective degree of complexity. In accordance with the mentioned criteria and the performed justified versions for practical application in real time, the following versions are presented in Table 2.

Table 2 delivers specific information about the application of the corresponding mechanical products in accordance with the educational, qualifying system and according to the subject. The patterns for knowledge verification (outside the scope of the audition work during the curricular term) are also shown.

The exercises which the Master Degree students perform within the confinement of the optional subject “Expert System” involve various types of tasks related to production rules, diagnostics and checkups for creative solutions. To that end, it is required to perform discussions, team-based work, diagnostics and monitoring along with preparations of recommendations and solutions.

Table 1. *Versions of 3D geometric models*

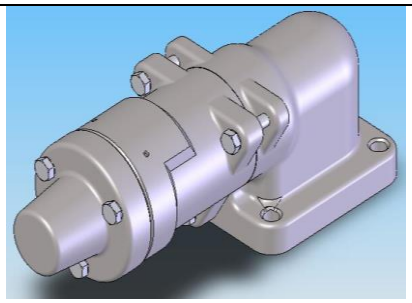
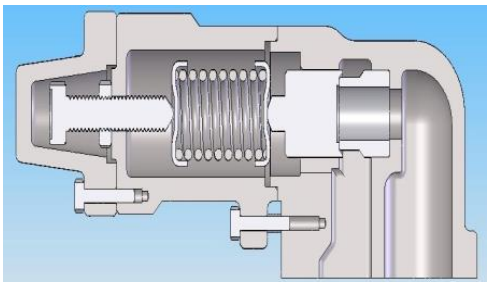
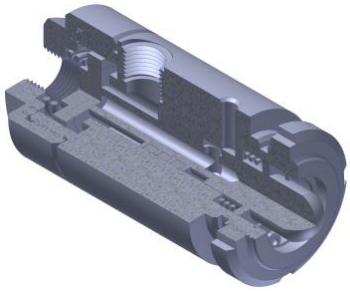
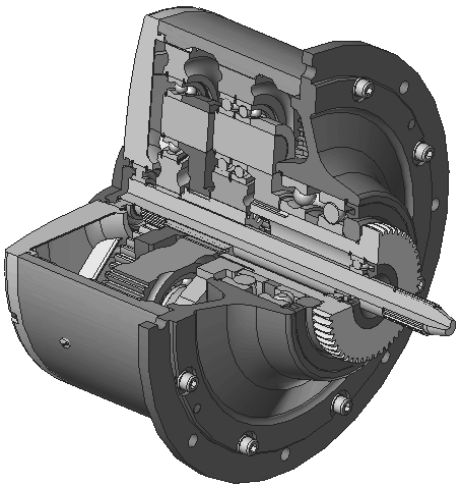
<table>
<tr><td colspan="3">Device</td><td rowspan="2">Analysis for the purpose of searching of constructive, technical solutions</td></tr>
<tr><td colspan="3">Hydro mechanical and pneumatic devices</td></tr>
<tr><td>Fig.1</td><td>Safety overflow valve</td><td> 
  </td><td>Given:
> Volumetric flow [m.h^{-1}];
> Standard pressure, [Bar];
> Viscosity of flow (non-Newtonian flow) [µPa.s].
Analysis and solutions:
> Choice of suitable steel grade;
> Choice of fittings;
> Choice of helical compression spring.</td></tr>
<tr><td>Fig.2</td><td>Pneumatic distributor</td><td>  </td><td>Given:
> Atmospheric pressure, [Bar];
> Mass atmospheric stream [m^3].
Analysis and solutions:
> Choice of steel grade and seals;
> Choice of helical compression springs.</td></tr>
<tr><td colspan="3">Mechanical drive systems</td><td></td></tr>
<tr><td>Fig.3</td><td>Planetary gear transmission</td><td>  </td><td>Given:
> Nominal power [Kw];
> Rotation frequency of flange – n $_{output}$ [min^{-1}].
> Rate of planetary gear transmission - i.
Analysis and solutions:
>Strength calculation and design of technical conception.</td></tr>
</table>

Table 2: *Applicability of the products*

Education degree	School Subject	Laboratory work	Tasks Control	Credits ECTS
Bachelor	Principles of design	Fig.1 ; Fig.2	Project Exam	5
Master	Expert systems	Fig.3	Paper Exam	5

4. An analysis of the results

Having explored the performed analysis and the suggested versions of mechanical products, one can form the following generalization:

> Rationalization has been founded as it concerns the usage of developed, suitable mechanical products for fundamental computer - aided designing which is to be performed throughout all engineering, technical specialties;

> A simulation model is presented as its purpose is to visualize the action of a safety - overflow valve as it acts according to a function of the characteristics of the fluid;

> For training of students from Master degree by optional subject "Expert systems" is justified versions for practical application to use the planetary gear transmission;

> This type of structure will improve the requirements of the European Credit System. (ECTS) that serves for the purpose of realization of mobilities via the Central European Education Program System which has been established between the Technical University of Sofia and the universities abroad.

5.Conclusion

Proper mechanical products have been developed as they have been incorporated into the training of students in the field of fundamental computer - aided designing which is included in the engineering, technical specialties. Various options of training of students have been offered on the basis of performed analyses and justified versions for practical application, developed 3D geometrical models of mechanical products. Some of them can be used for the purpose of computer - aided simulation, precise sizing analysis of assembly units and for the purpose of curs task designing.

The obtained results could be useful in order to establish better connections between technical subjects and profiling subjects throughout the process of training.

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