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The abilities and the use of AutoCAD and its place in the educational process

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Abstract

AutoCAD system is commonly available software which forms the basis for computer aided design and is a significant work tool for engineers, designers or constructors. This article attempts to present the system of computer-aided design.

Key words: object, integrated data model, computer aided design, technology.

Introduction

The progress in the field of information technology and dynamic development of computer programmes over the last 20 years have dramatically changed the workshop of a modern engineer. Currently, it is essential to use computer tools and specialized software in all stages of engineering design.

Technical universities wanting to adapt the training programme of a contemporary sanitary engineer to the labour market should work closely with companies that offer software for computer-aided design. The development in the field of information technology is extremely dynamic, and what years ago you had to laboriously design and calculate by hand is now, with the use of appropriate software, obtainable through much less effort [Drewnowski, Tuszyńska 2015].

The problem of computer aided design CAx systems is multifaceted. Taking into account the development of these systems over the years, it should be emphasized that it was a complicated and time-consuming process which must have entailed enormous expenses.

AutoCAD – programme design

AutoCAD is a programme created by Autodesk. It is used for two-dimensional (2D) and three-dimensional (3D) computer-aided design. Special-

ized versions of AutoCAD (eg. AutoCAD Mechanical) are also capable of performing engineering graphics 2.5D FBM method (Feature Based Model – modeling based on the quality of construction / aided modelling elements) [Montusiewicz 2011].

Initially AutoCAD was used mainly by mechanics, but with the growth of its popularity, Autodesk has expanded its offer with many special overlays, such as:
− AutoCAD Architecture,
− AutoCAD Electrical,
− AutoCAD Mechanical,
− AutoCAD MEP [Michna 2013].

Currently, library functions and interfaces specific to various industries are being added. AutoCAD is also used by architects, electricians and other designers.

Because AutoCAD has an open architecture (open source), it allowed external companies to create their own overlays that fit specific requirements of a given company. [Org / wiki / AutoCAD, 01.2016]

AutoCAD is a programme with a very flexible interface that can be individually adapted to your needs, habits and specific documentation which is prepared in a design office [Montusiewicz, Dziedzic, Borsch 2013].

Vector graphics is used to save drawings that have been created. In vector graphics, various basic objects called primitives are stored by using mathematical equations. A simple, an arc and a circle are examples of basic two-dimensional objects whereas a cube, a wedge, a cylinder and a torus exemplify three-dimensional ones. More complex objects are created by combining basic facilities. This type of graphics is ideal for creating projects and technical documentation. The files that store the contents of drawings are small in size. Vector objects can be freely scaled. This means that the enlargement of objects on the screen shows their new details, since the image on the monitor always arises anew through the conversion of mathematical equations of all the component objects [Montusiewicz 2011].

AutoCAD drawing files have the DWG extension and its equivalent in ASCII (American Standard Code for Information Interchange – coding system of letters by numbers) – DXF. DWG files have become the standard for CAD applications. In previous releases, it often happened that DWG files were not compatible between different versions of AutoCAD (this problem has been eliminated). DWG is both binary and proprietary format of Autodesk. Documentation on the format is not available to other software vendors in order to reduce competition in the market and maintain a monopoly position. Programmes from other manufacturers may use the files in this format through reverse engineering [https://pl.wikipedia.org/wiki/AutoCAD].

The potential of AutoCAD

AutoCAD has extensive design capabilities ranging from conceptional design to creating sketches and drawings. In addition to basic functionality it also enables the user to develop, visualize, document and share ideas with, for example, colleagues.

Conceptual design environment makes creating and editing solids and surfaces as well as tempering with them both easy and intuitive. Because all of these tools are available in one place, transforming ideas into projects becomes really easy. With navigation tools, designers can directly manipulate models during the process of their creation and editing, which greatly improves the working of the project.

At each stage of the project cycle, AutoCAD allows you to visualize the project with the aid of advanced tools such as animations and realistic rendering. Animation tools allow you to visualize any errors at an early stage of the project which makes it possible for the user to reduce design errors and eliminate them at an early stage of work.

AutoCAD allows you to quickly and easily transform design models into design documents that are clear and precise. The tools for creating cross sections and flat design allow us to work directly in the model to create sections and elevations, which can then be included in the drawings.

AutoCAD is equipped with advanced tools for data sharing, for example, the ability to export DWG files to older versions of DWG as well as the ability to export and import DWF files with notes and tags. At the same time it makes it easy to import DWF files and work with them as drawing "washers". It is also possible to publish drawing files in Adobe PDF format [www.aplikom.com.pl/autodesk-autocad].

Objects found in the AutoCAD computer drawing sheet can be divided into:
- geometric objects,
- objects that are fillings (different types of hatches and gradient fillings), objects that are dimensions,
- objects of a block type (internal or external),
- blocks with attributes and texts.

It should be added that in the case of modeling in three-dimensional space and the creation of photorealistic visualization other objects are also identified such as * lights,
- texture (from the library program and as a bitmap in the form of photos),
- elements of the landscape (can be fractal objects),
- background,
- cameras [Montusiewicz 2011].

The use of CAD system

The features of CAD system make it an attractive tool commonly applied in different fields of engineering such as:

- mechanical – creating two-dimensional drawings, 2D and 3D three-dimensional models of machine parts and equipment,
- Electrical – design of integrated circuits, Running tracks, design of electrical installations,
- Building – building design, creating models for town-and-country planning. [http://mfiles.pl/pl/index.php/CAD],

   Computer-aided engineering analysis allows, among others, to carry out:
- various types of calculations, including calculation of strength,
- simulation of various types, e.g. preparing variant structural forms based on strength calculations,
- various kinds of visualization,
- single and multi-dimensional optimization, eg. structural form of machine components,
- selection process prior to decision making.

   The CAD system also consists of various tools and techniques that allow Aided Engineering. They are used, among others, in:
- design,
- geometric modelling,
- computational analysis, finite elements method(FEM),
- creation and development of design documentation,
- the development of technical documentation for conventional machine tools [Michna 2013].

   Every subsequent programme version either introduces completely new features or updates the existing ones on the basis of new rules. Interface is also subject to changes.

AutoCAD in the educational process

   The process of education concerning CAD system can be initiated even in junior high school. It seems more important, however, to focus on technical and vocational schools. Due to the growing demand for engineers who are knowledge able about CAD system , schools should form computer design oriented classes. However, taking this type of action may cause a few problems. Both the problems and the methods that help to prevent them are shown in the table (Table 1).

   Education at universities is another issue. Universities assume that a student thoughtfully and carefully selects his field of study. The problem, however, lies in the way of education, and more specifically in its effectiveness. An example way of tackling this problem was offered by Koszalin University of Technology. The specialty Computer Technology in Production Engineering prepares students to design and manufacture objects in integrated CAD/CAM/CAE systems. The structure of objects is based on the logic of the flow of information in subsequent stages of production technical preparation combined with concomitant variety of computer techniques (Fig. 1).
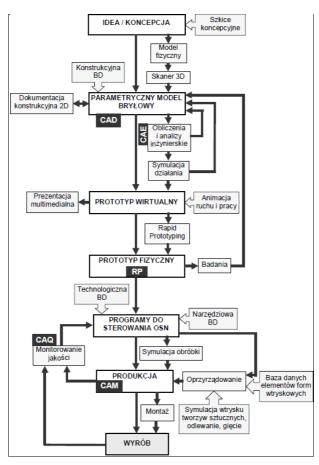
Fig. 1. Computer technology in the product manufacture development process
[Plichta, Plichta 2014]

Table 1. CAD education in technical secondary schools: problems and solutions
[Sulkowski, Pokutycki 2011]

The root of the problem	Remedy
Diversified machinery	Greater participation of employers in the education process. The use of EU projects. Increasing expenditure on the part of authorities in charge of running technical schools.
Low levels of recruitment to a vocational school training operators of machine tools	Continuous and systematic promotion of the job (MEN). Changing the name of the job to a more attractive one, eg. computer driven machine tool operator. Making parents aware of the benefits of sending children to vocational schools. "Ordered" job, a scholarship.
Lack of modernization and tool refitment. a Shortages in the supply of semi-finished products	The use of EU projects Increasing investments on the part of authorities in charge, raising the awareness of the costs of vocational education.

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The root of the problem	Remedy
Differentiation or no CAD software	Cooperation with the producers of the software. Collaboration with employers. Teacher training.
What to teach – the structure of curriculum	Employers' expectations versus curriculum. Updating the curriculum. Collaboration with employers. Choosing the ratio of CAD and CAM and work on the machines – CNC.
The total absence of modern measuring tools	Measuring arms. Laser sensors.

Summary

The development of systems for computer-aided design CAD, significantly affected the functioning of companies and manufacturing enterprises. Most importantly, these systems significantly simplified design and manufacturing processes.

Moreover, thanks to technological development, new concepts of the systems themselves and their development are being constantly introduced In this way, CAD systems are continuously enriched with the latest solutions.

Despite some imperfections AutoCAD remains the best programme to design two-dimensional drawings; this applies to both technical drawings and projects, which will provide the basis for the creation of three-dimensional models. Capabilities and affordability, offered by AutoCAD guarantee that the software for a long time will remain an ideal tool for those who want to become familiar with the functionality of CAD systems.

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