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Experience in using BIM on the basis of Magicad in course and diploma design in the specialty «Engineering Systems and Networks»

Abstract: *This paper considers application of the MagiCAD package at the chair of Construction of the Faculty of Architecture and Construction of L.N. Gumilyov Eurasian National University for automation of calculations and drawings when performing course papers and diploma projects to the subject «Design of heating systems in residential and public buildings».*
Key words*: CAD, 3D modeling, AutoCAD, MagiCAD, Danfoss CO, World Class College, 3D program, Computer Assisted Design of heating and ventilation systems.*

The modern system of higher education when training bachelors of technical specialties is characterized by one negative trend, namely, reduction of hours allocated to study of natural sciences and general professional academic subjects, which contradicts the growing high demands for quality of fundamental training of technical university graduates [1]. This leads to the students experiencing difficulties when studying engineering and graphic academic subjects, when performing coursework projects and at the stage of diploma design work completion.

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This stage of information systems development is characterized by wide implementation of CAD (computer-aided design systems) into engineering practice. In CAD the use of 3D modeling is more and more prevalent, the study and application of new tools of software systems requires a developed spatial imagination and sufficient geometric training of the student.

An example of such a tool for three-dimensional modeling can be the MagiCAD software package [2] developed by the Finnish company - Progman Oy - and designed for computer-aided design and calculation of indoor engineering systems, allowing to increase by times the efficiency of ventilation and heating projects completion. This CAD system is an alternative to other well-known programs, such as AutoCAD Mep and Allklima for AutoCAD, and in terms of speed and quality exceeds such widespread 2-dimension CAD programs in design organizations of Kazakhstan as Danfoss.CO and Herz CO. MagiCAD software package allows to significantly reduce labour expenses at calculation of heat losses and hydraulic calculations of heating systems, aerodynamic calculation of ventilation systems, it has a user friendly interface, is reliable and efficient in operation.

MagiCAD software package has gained wide popularity in North Europe, Baltic States, Russia both due to the advantages listed above and due to a number of features inherent therein. The main ones among them are: 3D modeling, ample opportunities for documentability of calculation results, efficiency in solving of set tasks and visualization of their calculation results in the form of various kinds of graphs, charts and etc. This CAD is relatively recently used in design organizations of the Republic of Kazakhstan.

The teacher in the introductory part tells about the purpose of MagiCAD CAD software, the advantages in comparison with other similar software. With the help of Notebook computer and multimedia projector with demonstration on interactive whiteboard he shows the sequence of the software installation, describes the interface - menus, panels, dialog windows. Further the sequence of calculation and system design is described.

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Then the students get finished floor layouts of the task options made in AutoCAD and with the help of the «Room» application of the MagiCAD package they simulate the enclosing structures of the premises and make a calculation of the heat losses. Here also in layers by clicking the initial information is displayed, if necessary, for the following heating and ventilation calculations.

In MagiCAD during hydraulic calculations of heating system the student first creates a 3D model of heating systems on facility floors, and then he establishes virtual connections between horizontal systems on the floors and simulates the total system of the building. In the process of modeling the type of heating devices, types of pipes, shut-off and control valves, heat carrier parameters are selected. Debugging and calculation of the system is performed, if necessary, changes are introduced into the calculation scheme. Whereas all components of the drawing: pipes, heaters, rooms have metric information, buy they are drawn at scale. Specification is automatically output in AutoCAD environment or exported to Microsoft Excel. All text and geometrical information: length of pipe section, type of pipe, type of heater, information about object configuration, name and load of the room are entered into a separate chart. All footnotes, section diameters, number of sections and type of heaters are displayed automatically.

If we compare MagiCAD software package with Danfoss CO software, in which students and a vast majority of Nur-Sultan design and engineering bureaus designed heating systems during previous years, the advantages of the first one are obvious. Danfoss.CO is a separate stand-alone program not integrated into AutoCAD CAD. All calculation results made in this program had to be redrawn «from scratch» in AutoCAD. In Danfoss CO a lot of time is spent on routine operations, all the actions have to be performed «manually», the spatial heating system is modeled conditionally in one plane. Secondly, the lengths of the segments did not contain the real metrics of the pipeline sections, the rooms were shown as rectangles conventionally and did not take into account real dimensions thereof. In order to solve this problem the teacher had to show the formal and logical connection between the simulation objects on the

blackboard or on the slide. All of this made it difficult to perceive the material when modeling on Danfoss CO and reduced the speed and quality of design by times in comparison with MagiCAD software package.

MagiCAD is a 3D program and is fully integrated with AutoCAD CAD. Furthermore it is possible to model engineering systems, when architects and designers provide floor plans in plane - in AutoCAD and when information is given in 3D - in Autodesk Revit. Thus the complex application of MagiCAD CAD reduces the rough, routine part of the designer's work by times.

The above features of the package were used by the authors in the design of heating and ventilation systems of the facilities included in the complex of «World Class College» buildings in Nur-Sultan in 2015: dormitory for staff members, 5 dormitories for students, parking, sports complex, administrative building of «Kasipkor» holding.

As a result, we can state that during the first year of professional training the students - civil engineers in the process of learning computer graphics achieve an average level of professional training only. They acquire certain professional knowledge, abilities and skills, but do not consider the theoretical connection between the material fundamentals and the practical side; their ability to summarize and analyze information is underdeveloped.

By the fourth year most of the students, particularly when studying the "Computer Assisted Design of heating and ventilation systems" course, have reached a higher level of professional knowledge, skills and abilities, professional interest, a sufficient level of design thinking and have the need for self-actualization. The introduction of this work methodology awakens a sustained interest among students in professional training in general, in deepening of knowledge and skills in the field of professional activity.

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«Инженерлік жүйелер және желілер» мамандығы бойынша курстық және дипломдық жобалауда Magic негізіндегі BIM пайдалану тәжірибесі

Аңдатпа: Бұл мақалада Л.Н. Гумилев атындағы Еуразия ұлттық университетінің сәулет-құрылыс факультетінің Құрылыс кафедрасында «Тұрғын және қоғамдық ғимараттардағы жылыту жүйелерін жобалау» тақырыбы бойынша курстық және дипломдық жобаларды орындау кезінде есептеулер мен сызбаларды автоматтандыру үшін MagiCAD пакетін қолдану қарастырылады.

Кілт сөздер: CAD, 3D модельдеу, AutoCAD, MagiCAD, Danfoss СО, әлемдік деңгейдегі Колледж, 3D бағдарламасы, жылыту және желдету жүйелерін Компьютерлік жобалау.

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Опыт использования BIM на основе Magic в курсовом и дипломном проектировании по специальности «Инженерные системы и сети»

Аннотация: В данной статье рассматривается использование пакета MagiCAD для автоматизации расчетов и чертежей при выполнении курсовых и дипломных проектов по теме «Проектирование систем отопления в жилых и общественных зданиях» на кафедре строительства архитектурно-строительного факультета Евразийского национального университета им. Л.Н. Гумилева.

Ключевые слова: САПР, 3D моделирование, AutoCAD, MagiCAD, Danfoss CO, Колледж мирового класса, программа 3D, компьютерное проектирование систем отопления и вентиляции.

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