Forming 3D Modelling Skills in Future Engineers Through BIM (Building Information Modeling)

Khaydarov Jonibek Kamol Ugli

Samarkand governmental architectural building university professor

Abstract

In this article, future engineers' opportunities for learning 3D modelling, programming 2D/3D modelling through computers, and the introducing design technologies using BIM technologies will be reviewed. The given materials may be intriguing for technological university professors whose jobs are related to engineering as well.

Keywords: Computer modelling, information technology, model, layout, KYLT, 3D modelling, project, BIM technologies.

Introduction

Nowadays, the graduates of vocational education need to possess work experience and high-quality IT devices in order to be in demand in the labor market. Due to the development of the IT environment, the ability to present data is becoming more important, as is clearly creating information models. Encouraging students to utilize models in their IT fields can resolve educational issues and improve individuals' motivational and professional features. This, especially, suits technical specialty students, specifically future engineers and builders.

The use of computer technologies in conducting preliminary studies, developing design solutions, and preparing design documents significantly reduces the time spent completing project tasks. Currently, several dozen software products are used that allow to effectively create the most complex design drawings and modern projects of civil and industrial buildings. [1] 3D modeling in construction and architecture is one of the most popular directions for using information and communication technologies. Our institution is paying great attention to this problem. Software products such as Kompas-3D, AutoCAD, ArchiCAD, Revit, and 3D Max are successfully used for these purposes.

KYLT computer-aided design systems allow you to quickly and efficiently develop projects and perform routine work in a minimum amount of time. Various software packages for computer graphics, three-dimensional modeling, automated drawing and design, visualization, and presentation provide modern professionals with the widest range of opportunities to implement creative and professional solutions. Having mastered the tool and the ability to properly use computer simulations, the student becomes not only a student but also a researcher who can independently and creatively identify and solve very large-scale problems.
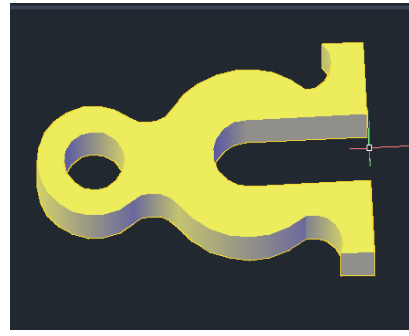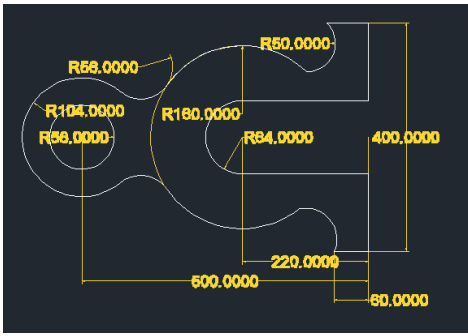
Effective teaching of 3D modeling is impossible without a prepared methodology and didactic materials. For this purpose, lecture texts, presentations, and instructions have been developed for practical training, to which students now have open access in the credit module system using the hemis platform. As part of training on information technologies in construction, we will consider Compass-3D and AutoCAD programs for automating engineering and graphic work, create three-dimensional models of simple parts, learn to work with drawing and editing tools, and set the dimensions in the drawing. [3] We will review the basic concepts of three-dimensional modeling and computer modeling techniques. Kompas-3D computer-aided design systems, AutoCAD, are designed to automate design and technological work and provide high-efficiency processing and production of drawings and design documents, as well as allow the creation of surfaces, solid-state models of designed parts, and assembly units. In addition to the Kompas-3D graphic editor from the Russian company ASCON, it includes a number of software products and libraries that significantly increase the efficiency and quality of design. It is equally convenient for mechanical engineering, construction, and architecture.
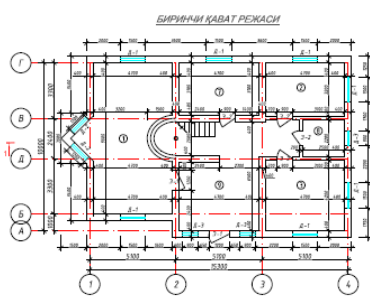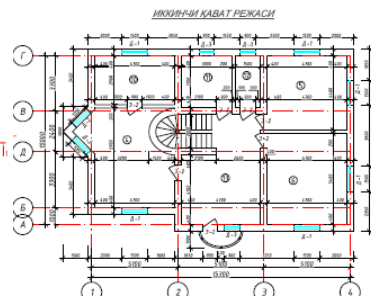
First floor plan   Second floor plan   Façade between the axes

In the upper course, we will move on to the execution of construction drawings: floor plans, sections, facades, nodes, etc. We will analyze examples of the execution of drawings and the creation of three-dimensional models. We carry out control and test tasks to check knowledge, skills, and qualifications for working with these programs. We independently create computer models of buildings and structures. Special attention is paid to modern computer modeling technologies. [1] BIM is information modeling of buildings and structures, which is broadly understood as any infrastructure object. When the building and all things belonging to it are considered as a single object, the collection and complex re-evaluation of all architectural, design, technological, economic, and other information about the building with all its relations and dependencies in the design process. includes working. The peculiarity of this approach is that the construction object is actually designed as a whole: changing any of its parameters automatically changes the parameters and objects related to it, up to drawings, visualization, and technical specifications. will come. In 2018, Yekaterinburg hosted the largest professional skills competition

among young professionals in worldskills. Hi-Tech, Russia's largest local industrial enterprises, where the competence "information modeling technology (BIM)" was presented for the first time.

Knowledge of computer modeling is used in the design of students' courses and theses and helps to develop the following competencies among students:

Ability to understand the possibilities of using IT in industry, construction and architecture; education of professionally important qualities, the ability to apply the acquired knowledge in professional activities, responsibility for the work done, intelligence and caution in performing practical work; the ability to solve practical problems and use the computer correctly in their professional activities; acquiring information culture, analyzing and evaluating information using information and communication technologies; work in a team and in a team, communicate effectively with colleagues, management, consumers; organizing one's activities, choosing typical methods and methods of performing professional tasks, evaluating their effectiveness and quality; the ability to apply knowledge from relevant disciplines; formation of independent mental work skills.

The transition to a new generation of standards based on a competency-based approach involves the extensive use of advanced educational technologies. Such methods may include the use of design technologies. According to the new standards of the state educational standard, students are expected to implement individual projects from the first year. From my own work experience, I can say that many students prefer 3D modeling projects. The project method is focused on the independent activities of students: individually, in pairs, or in groups. Students perform for a certain period of time. A distinctive feature of project activities in training sessions is that the teacher controls the process of project development and actively participates in its creation. But in such classes, time is strictly limited and learning materials must be mastered by each student, so such projects can last several lessons. [2] With the skillful organization of the project creation process and its correctly selected product, this method is very effective because it allows creating conditions for students to identify a problem, find ways to solve it, and build information skills (this can be a textbook, additional materials, access to an electronic library, a book, or Internet resources. in a computer class) to summarize it and present the conclusions in the form of a certain final product—an information computer model.

For the sake of clarity, I would like to give a brief description of the project implemented in various AutoCAD software products.

It is to form students' computer graphics skills. The design methodology and skills of students will increase while completing this project in AutoCAD. In this, the student's independent creative, creative, cognitive, and figurative thinking skills develop.

To complete the project, let's choose this detail.
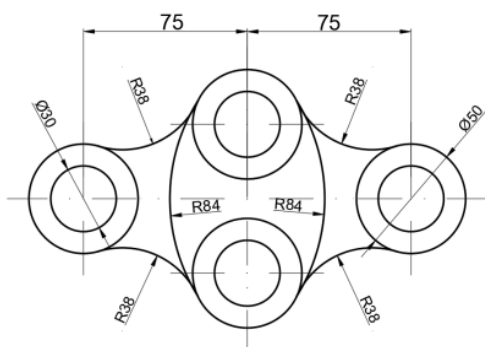
First of all, we start the AutoCAD program, in order to create a detail in the project, we use the CIRCLE command from the tool panel to create circles in the AutoCAD program, we create shapes by indicating the radius of the circles shown in the detail.

In the second step, we make lines of the circles of the indicated size and cast the circles in place. We can prepare the state of the given detail by combinations of lines and circles.

In the third row, we use the ellipsoid shape to join the circles from the squilite, for this we use the FILLET command to join the ellipses on the two circles, and join these two circles in an ellipsoidal way, repeating this process in 5 places of the detail to join the circles.

Fourthly, we can clarify what dimensions are poured into which part of the detail, for this we pour the dimensions using the Dimension command. You can also change the color using this command. When using the command, to set the size of a line, we mark it from its beginning and end, and our drawing is ready.

In the fifth step, we make the shape of the detail look 3D. For this, we use the EXTRUDE command. After choosing this command, we select the object, move the mouse pointer up and enter the size of its elevation. A 3D view of the joint detail is ready for us.

The speed of preparing people for digital technologies is starting to lag both in the world and in Uzbekistan. Civil engineers of the future face a number of problems, some of which can be solved during the study phase.

A common and very serious mistake is the non-compliance of the project with the requirements of technical regulations in terms of safety. Let's say that the basis of calculation of constructive decisions made in the project is not provided, or the safety of structures and utilities entering the construction zone is not confirmed. The design of fire protection systems is often carried out in deviation from the requirements of technical regulations and fire safety standards. These are gross errors - the operation of an object built on the basis of such documents is simply dangerous.

The complexity of teaching without the use of modern computer technologies is clear: there are no layouts for each specific task, because there are no pictures that allow you to review and evaluate the solution from all angles. Drawing problem-solving on the board is not visual, but it is sometimes disastrously useless to increase students with limited time and inadequately prepared paper drawing tools. A modern student who chooses the specialty of a civil engineer or architect sometimes does not always understand the specifics of these professions. Most of them did not go to drawing school and therefore do not even have the basic skills to make drawings.

Students should be able to create a single multidimensional space according to the requirements of modern design.

Currently, BIM is used in non-governmental housing construction and in the private sector. Some industrial companies are launching their own industry standards, so the problem of applying BIM technologies is solved within the local industry. But in general, things are more complicated in the construction industry in the country. First, the high costs required for the introduction of new technology in Uzbekistan hinder the development of BIM. They are represented not only by the financial costs of purchasing new software, updating personal computers, but also by the need to train employees, adapt all company workflows and the entire team to new requirements and new business processes.

Unfortunately, domestic software products cannot yet compete with Western technologies. Often the problem for Uzbek companies is that initially BIM is a foreign technology, that is, they require to adapt the standards to Uzbek standards.

Often, the pace of modern construction lags behind the pace of design, and updating design solutions is at the edge of construction. This leads to the impossibility of normal work with models, and it is necessary to return to old analytical methods, which increase the probability of error.

Photogrammetry can be used for dismantling and construction objects. However, the process of modeling unsystematic processes or building capture objects of this method can be very labor intensive. The best option to solve this problem is to shoot in stages, that is, to go to the field and cut, for example, in two weeks or in a month - to compare the real situation with the model, which is a bit difficult in the current training framework.

The rate of SMR, late or early, the ratio of construction stages to costs - this information is the most important for making accurate and timely management decisions.

The graphical information model becomes an excellent tool for managing the stage of construction and assembly work. Such an information model serves as an assistant in planning work for all executors. Since Bim technology is a data collection process, the opportunity it provides is a quality control system. The technology makes it possible to collect information in the real estate model not only from the point of view of project documents, but also from the point of view of executive documents. Accurate coordination of tasks, quick and accurate determination of the scope of work, coordination with equipment suppliers when ordering materials, etc. monitoring of safety and labor protection. At the same time, with the construction of the building, the ability to influence the cost of the project decreases.

Thus, combining optimal methods of learning 3D modeling technologies in the educational process with design technologies in independent activities allows for the successful formation of students' professional competences. Self-representation in practical independent activities, solving tasks, and learning can be more practice-oriented, making the learning process more interesting. The results of work on integrated projects allow for the formation of not only the basic skills of 3D modeling but also their use in related disciplines. It is the use of design technologies and interdisciplinary communication that ensures the formation of a competitive specialist in the integrated information space of modern society.

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