

# Building a 3D model of hydraulic structures using BIM technology

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**Abstract.** In the article, the role of graphic programs in the engineering sciences in the educational system, especially in technical higher education institutions, through them, we can see that the issues related to Build Art technologies, which are the demand of today, can be easily and conveniently solved. The ability to analyze the spatial properties and tasks of subjects is an important component of the graphic preparation of students. In the field of graphic education, development of students' spatial imagination, imaginative analysis of spatial images have been adding a significant share to the creation of content.

## 1 Introduction

Nowadays, 3D modeling is widely used in Marketing, Architecture and Design, Cinematography and other fields. 3D modeling plays an important role in the process of creating a prototype of future buildings or conducting a presentation of a product produced by a company. Thanks to the creation of 3D printing, 3D modeling has taken another step forward and has become a more demanding field in today's society. Now everyone has the opportunity to print on a 3D printer, whether it's a picture he drew or an object he copied from the Internet, a designer model or a character of our favorite superhero. Of course, not everyone understands how to work and model in 3D software. Because of this, the demand for a profession in the field of 3D modeling has increased and has been growing for 10 years [1-2].

## 2 Methods

3D modeling refers to the process of developing a 3D model (or a frame model in the form of a three-dimensional object) using specialized software. A 3D model is created using many points connected by lines and curved surfaces. The areas in which three-dimensional modeling is used are constantly expanding. It is as follows: games, i.e. modeling of realistic characters; medicine - creation of individual models of human body organs; engineering - development of models of vehicles, new devices and structures; cinematography covers areas such as the creation of various special effects and fictional characters. Also, 3D-modeling is used enough in the field of advertising.

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### 3 Results and discussion

New possibilities of three-dimensional modeling have significantly reduced the time it takes to create cartoon characters. The software allows you to easily give movement to the object and spend a minimum of time on it. An experienced user often uses a number of three-dimensional modeling programs to create his project [6]. The joint use of the above-mentioned programs allows creating realistic game scenes and making the product look perfect [4], [5]. In the graphic tasks completed by the students, errors were made in the graphics program when imagining a clear image of the graphic tasks on the basis of 3D modeling of the complex views given by the students. They are as follows: some students have errors in building a 3D model of the given task due to the lack of development of spatial imagination and the process of reading drawings; There are errors in the use of “Vityagivanie”, “Vidavit” commands, which are necessary to build a 3D model of a given task in the AutoCAD graphics program; Since the commands of the AutoCAD graphic program are in Russian and English, they made mistakes when using these commands.

These results show that the students need to develop spatial imagination, which is the main problem in the process of studying "Computer graphics", and to create excellent skills in graphic programs. To implement these in the educational process, it is necessary to use the following: to determine the interest and ability of students in science using automated software systems based on "Questionnaire"; based on the obtained results, determine the teaching method in certain groups; (this can be based on the results of the "Questionnaire" of the students in the group); Development of theoretical and practical topics based on 2D and 3D modeling; development of a multimedia electronic guide based on 2D and 3D modeling for the educational process and introduction to the educational process; to use the methods of completing graphic tasks on the computer for the topics of the curriculum when mastering graphic programs; set up automated multiple-choice test control; organization of independent education.

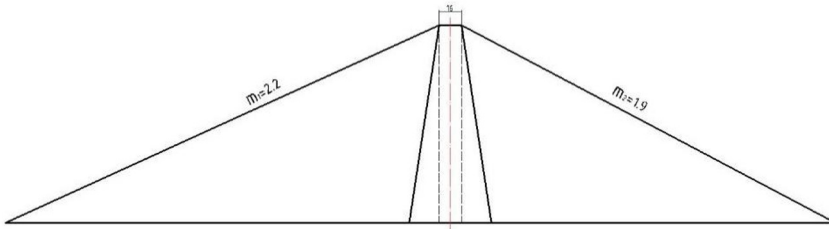
Taking into account the above and analyzing the results of the experiment, the use of the “Three-dimensional modeling” tool, which has the capabilities of a graphic program, in the development of the spatial graphic imagination of students from graphic subjects, the application of computer technologies to the teaching process of “Computer graphics” and the design of the educational process based on this, are important in the process of teaching the subject. It has been proven that it is relevant to develop the methods of performing graphic tasks on a computer, to form a database of test tasks with different levels of complexity, to create “Electronic multimedia software tools” for the subject and to introduce them into the educational process.

But the development of primary creative activity of students in graphic subjects shows that it is necessary to start with «General education schools» and «Vocational» education system, because graphic subjects, including «Computer graphics», require the ability of students to visualize spatial graphics more than other subjects. In order to achieve it, the student must master the knowledge of the subject given in the general secondary school program in time. As we all know, students acquire knowledge and skills related to the subject of «Computer graphics» in the general secondary school program during the «Drawing» lessons in the primary grades, and in the upper grades during the mastering of the «Drawing» subjects. These subjects serve as a basis for students to master a number of graphic subjects such as «Technical drawing» in the course of vocational education and «Drawing geometry and engineering graphics», «Engineering graphics» and «Computer graphics» in higher education institutions. Therefore, the process of formation of students' basic knowledge of these subjects must start from the upper classes of the general secondary school and develop in the process of studying in vocational education.

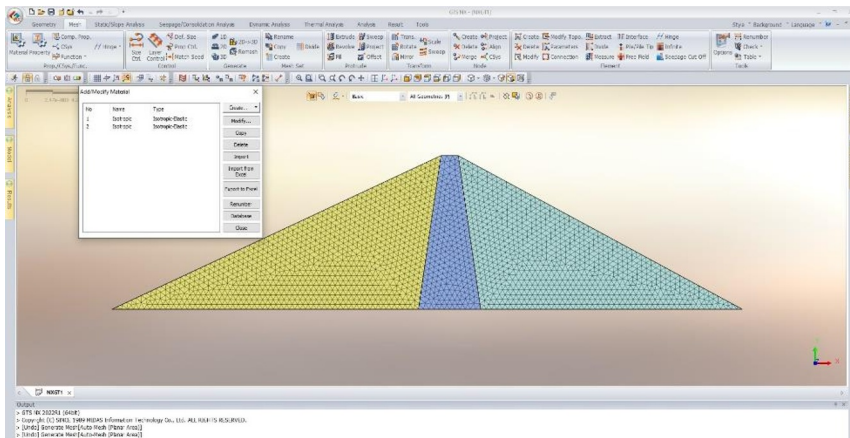
The initial analyzes conducted proved that by using computer technologies in the educational process of "Engineering computer graphics" and organizing practical training classes based on this with the help of multimedia electronic training manuals, we can ensure the development of three factors that are important for students to successfully master the science of engineering computer graphics.

Thus, by using the "Multimedia electronic training manual" in the practical lessons of the "Engineering computer graphics" subject, we can achieve the development of the factors necessary for the student's successful mastery of the subject, and they are as follows:

Virtually all 3D software tools have a relatively similar interface and modeling tools, but programs differ in their specific features, as well as computational algorithms for lighting, animation creation, and image visualization.



**Fig. 1.** Export project in Midas gnt nx program based on the given drawing of the dam

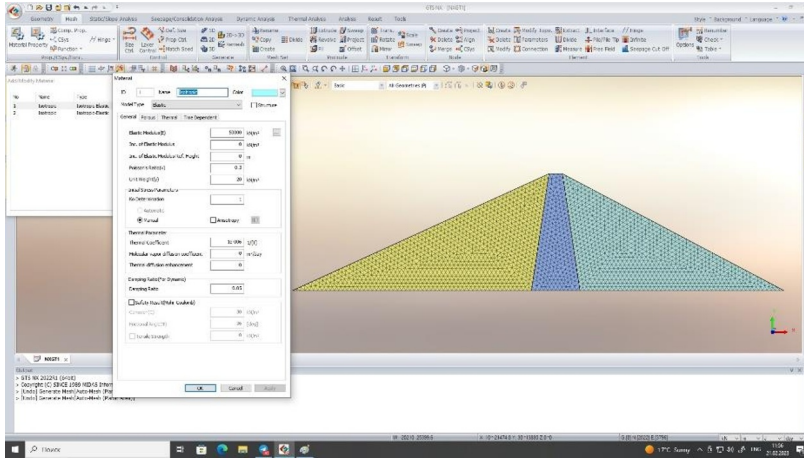


**Fig. 2.** Finite element analysis in the Midas gts nx program based on the given drawing of the dam

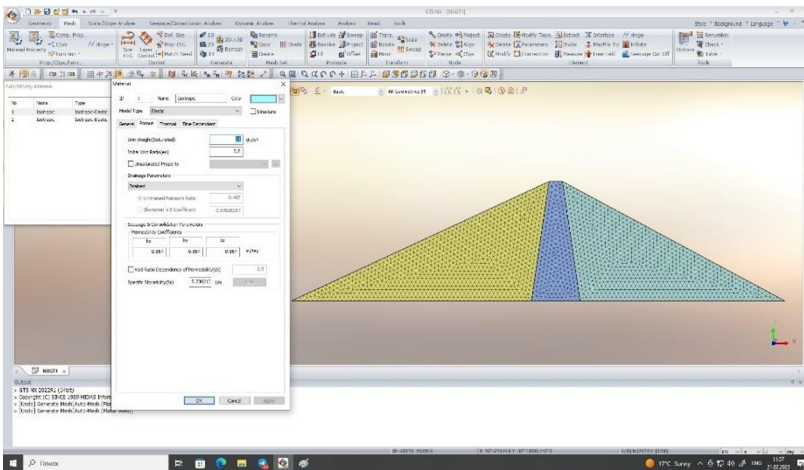
There is no universally accepted answer as to which 3D software is good or bad. Each user considers the 3D software tool that is suitable for him important for this question [7]. How well the user can work with the 3D software he works with and his creative capabilities (in addition to knowing the tools, it is desirable to acquire artistic skills, color harmony, composition) [7]. Therefore, the designer decides what program to prefer. To explore the possibilities of three-dimensional modeling software in detail, it is necessary to create a 3D scene consisting of three-dimensional elements. Each of the 3D software has its advantages in a specific area [7-18]. A brief description of the main programs for three-dimensional modeling:

1. **Autodesk Maya** is a serious graphics package that has a number of advantages compared to other programs. It includes the following: modeling using subdiv primitives, convenient work with materials, the ability to draw various effects on the modeled object, an advanced system of animations, etc. It is widely used to create

realistic interiors, characters, and visual effects in the motion picture and computer game industries [4].



**Fig 3.** Finite element analysis in the Midas gts nx program based on the given drawing of the dam



**Fig. 4.** Finite element analysis in the Midas gts nx program based on the given drawing of the dam (the result)

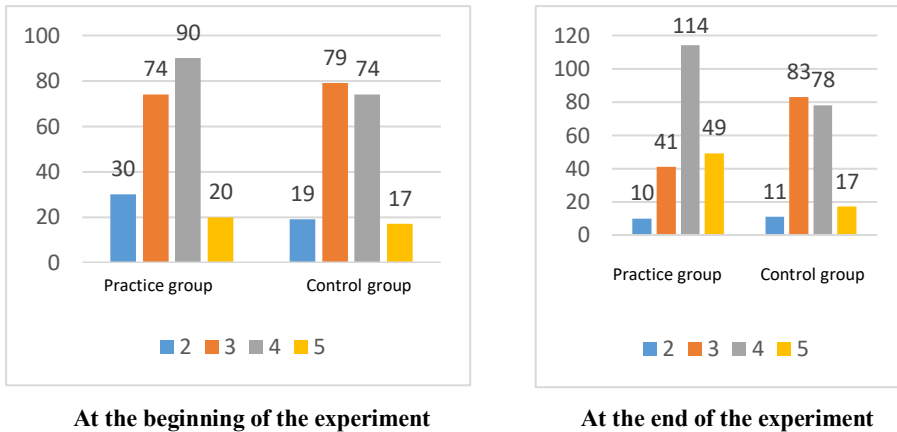
2. **NewTek LightWave 3D** is a graphics package with very convenient animation tools and high-quality rendering. Convenient for creating three-dimensional graphics in television format.

The results of students' knowledge and skills in conducting the educational process based on the methodology of using a multimedia e-book, multiple-choice graded tests, an intellectual computer game, a set of graded tasks, a video lesson in the teaching of the subject "Engineering computer graphics", and the results of tests, answers to questions, and their positive solutions in the performance of practical tasks It was determined based on their findings and the results of the intellectual computer game.

The level of knowledge of the students in the groups was taken into account. In order to determine the effectiveness of the proposed methodical system, the results of the control training and summarizing training received from the students were analyzed in terms of quality and quantity indicators.

Again, using these variation lines as above, we obtained the following results using the statistics section in the Formulas menu of the Excel program (see Table 1).

Based on the statistical data in Table 3.2.4, we can make the following conclusion. 12% efficiency was achieved at the Karshi Engineering-Economic Institute, 14% at the Tashkent Architecture-Construction Institute, and 10% at the Namangan Engineering-Construction Institute. In general, when we compare the final results of all higher education institutions, 11% had a positive effect. We also present this in the form of a diagram (see Figure 5).



**Fig. 5.** Comparison chart of overall results in higher education institutions at the beginning and end of the experiment

So, the methodology we used had a positive effect.

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## 4 Conclusion

Students' knowledge of modeling is formed in the process of mastering the reality of the environment, drawings. In higher education, students should acquire and understand the most important three-dimensional aspects and features of the real world - two-dimensional and three-dimensional, the basic criteria of drawing and graphic software, acquire a number of skills and abilities, and follow them in practice, there are the most favorable conditions for them to acquire the necessary knowledge to express their feelings accordingly.

Increasing the teacher's responsibility in the education of students by using the means of teaching engineering computer graphics, providing them with pedagogical and psychological knowledge is one of the current socio-pedagogical problems.

They will be able to use the three-dimensional modeling tool in the teaching of engineering computer graphics. Methodological developments, set of tasks, multimedia electronic guide developed on the basis of scientific analysis of research results and tested in practice are used in all higher educational institutions of our republic, in the conditions of increasing demand for teaching graphic programs, they will not only help students, but also Engineering in computer graphics and will have the knowledge, skills and abilities to use three-dimensional modeling.

**Table 1.** The results of the statistical analysis of the variation series compiled at the end of the experiment

	average	dispersion	Average square root	Coefficient of variation	Confidence intervals
Karshi Institute of Engineering Economics	3,96	0,67	0,82	20,73	(3,78; 4,13)
	3,55	0,53	0,73	20,47	(3,39; 3,7)
	1,12		The observed value of the criterion $T_{\text{observation}}=3,49$		Critical point $T_{\text{cr}}=1,96$
<b>Summary</b>	$T_{\text{observation}} > T_{\text{cr}}$ H1 basic assumption accepted				
Tashkent University of Architecture and Construction	3,95	0,61	0,78	19,84	(3,75; 4,15)
	3,48	0,69	0,83	23,86	(3,25; 3,71)
	1,14		The observed value of the criterion $T_{\text{observation}}=3,03$		Critical point $T_{\text{cr}}=1,96$
<b>Summary</b>	$T_{\text{observation}} > T_{\text{cr}}$ H1 basic assumption accepted				
Namangan Engineering and Construction Institute	3,92	0,50	0,71	18,06	(3,75; 4,1)
	3,57	0,43	0,66	18,48	(3,39; 3,74)
	1,10		The observed value of the criterion $T_{\text{observation}}=2,83$		Critical point $T_{\text{cr}}=1,96$
<b>Summary</b>	$T_{\text{observation}} > T_{\text{cr}}$ H1 basic assumption accepted				
<b>TOTAL</b>	3,94	0,60	0,78	19,71	(3,84; 4,05)
	3,53	0,55	0,74	20,89	(3,43; 3,64)
	1,11		The observed value of the criterion $T_{\text{observation}}=5,42$		Critical point $T_{\text{cr}}=1,96$
<b>Summary</b>	$T_{\text{observation}} > T_{\text{cr}}$ H1 basic assumption accepted				

These processes require teachers to regularly increase their level of pedagogical literacy, that is, by reading methodological literature on modern graphic software education, watching master classes, using electronic manuals, reading relevant articles in scientific and international journals, and studying students in teaching engineering computer graphics to students. they will have the ability to use modern graphic programs in the teaching of engineering computer graphics.

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