

COMPREHENSIVE TABLES OF THEORY OF ENGINEERING GRAPHICS AND THEIR USE IN EDUCATION IN THE SPECIALTY 191 ARCHITECTURE AND URBAN PLANNING¹**A.O. Perperi,**

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Abstract. Lectures on engineering graphics, for students of architectural specialties, according to the curriculum, require a significant amount of visual materials. It is advisable to transfer the theoretical provisions of engineering graphics in the form of a table. This approach makes it possible to structure the material of lectures in the form of complex tables of theory, with the main emphasis on images. Theoretical material in the form of complex tables allows more successful use of heuristic learning, which is appropriate since there is almost no use of drawings in schools nowadays. Such techniques involve consideration of several approaches to solving problems and in general the diversity of the entire course of lectures on engineering graphics, which can be done using generalized tables of theory. For example, the four main problems of descriptive geometry, which are solved in three ways to convert the plot, are provided on one sheet. Descriptive Geometry - Engineering Graphics grammar prepares the student to express their thoughts through drawings and understand each other throughout forms of drawing.

Keywords: engineering graphics, structure, search-heuristic training, geometry-grammar.

Problem statement . Previously, the main tasks were set before the descriptive geometry: the image of three-dimensional objects on a plane (surface) and the solution of metric and projection problems related to three-dimensional objects in projection drawings [1,9]. Now, thanks to the development of computer graphics and computational experiments, natural experiments are being successfully replaced [2]. It is possible to use the apparatus of descriptive geometry as a modeling, engineering apparatus. It is clear that computer graphics can develop only on the basis of extensive use of the laws of engineering graphics and computational geometry.

Analysis of recent research . Technologies have appeared, allowing to build a building with the help of a 3D printer. If you are building it, you need to understand what kind of building you want to have and whether it is possible to build it with this technology. Whatever the technology, but in order to build a building, it is desirable to have drawings. Of course, you need to be able to draw and read drawings. Learning technologies are also not standing still in the city. We have to part with traditional methods of presenting material when it comes to engineering graphics for architects, because now we need a very developed spatial thinking. We need to look for other forms of learning. One of the ways is to provide students with information in compact blocks and in this useful - complex tables of «theory of engineering graphics».

New technologies are widely introduced in business education - computer simulations. Significant funds are lost for the implementation of innovative Cisco Tele Presence technologies. Modern learning requires new methods of interaction with students using new technical capabilities [6]. Engineering graphics for architects is a specific discipline, where the main emphasis is on video. The use of laptops and mobile phones in students' classrooms can be useful in continuing to work both in theory and in practice on the board or on the screen. It is clear that

this requires a well-thought-out lecture script. Illustrative material is prepared in advance and this qualification complex tables of theory are very useful. The presence of information material in various forms allows you to quickly refer to any figure or table on the topic. Technical capabilities give the teacher more time for live communication with students. And yes, there is a possibility, what is the purpose of the lecture? If the goal is only specifics such as a point, a line, etc., it is one thing. It is quite another - if the goal is much broader - to develop students' thinking and in this case the dialogue with the group is very important. In our view, interactive interaction should remain at the heart of the learning process, and other approaches can only be ancillary.

The goal. Introduction of complex tables «theory of engineering graphics» and their use in training in the specialty 191 Architecture and Urban Planning.

The scientific novelty is that the information is structured according to the logic based on many years of experience with the audience and is presented in the form of tables. The usefulness is that it was possible to present a large amount of material on engineering graphics quite concisely and that is why to apply search-heuristic teaching methods.

Research objectives:

- Analyze the generalization of theoretical material using complex tables.
- To recommend complex tables «Theories of engineering graphics» in the educational process in the discipline of engineering graphics.

The main text. Lectures on the academic discipline of engineering graphics, for students majoring in 191 architecture and urban planning with a bachelor's degree, according to the curriculum require a significant amount of visual materials. It is advisable to convey the theoretical provisions of engineering graphics in the form of a table and visual material. This approach made it possible to structure the material of the lectures in the form of generalized tables of theory, with the main emphasis on the images. Theoretical material in the form of generalized tables allows more successful use of search and heuristic training, which is appropriate because in schools there are now almost no drawings.

Approbation of the visual manual on engineering graphics made on that principle is carried out [7]. It does not replace existing textbooks or lecture notes, because it has a slightly different purpose. It is assumed that it is useful to study the relevant sections of the course with a textbook, that is to say with a significant depth of theoretical material, and generalized tables are used as supporting material in lectures, practical classes, in independent work of students in engineering graphics. Where is the usefulness and novelty of generalized tables on engineering graphics for future architects? When using these tables, it became clear that not all sections of descriptive geometry are covered with the required depth, it is advisable to study some topics, so now this work continues [11,12]. Such techniques involve consideration of several approaches to solving problems and in general the diversity of the entire course of lectures on engineering graphics, which can be done using generalized tables of theory. For example, the four main problems of descriptive geometry, which are solved in three ways to convert the plot, are provided on one sheet. In other words, the basic methods:

- replacement of the plane of projections,
- rotation around the axes,
- plane parallel movement are provided on one sheet, which facilitates the analysis of the effectiveness and feasibility of a method in solving a particular problem.

This structuring of educational material not only simplifies the comparison of different methods, but also gives milestones that facilitate its memorization, makes it more promising to choose the appropriate method of transforming the plot when solving a particular problem. Comprehensive tables of the basics of the theory contain concise theoretical provisions from the course of engineering graphics, examples of solving constructive and applied problems. It should be noted that their feature is the theoretical material located in the generalized tables, and the table contains a set of basic knowledge. Sometimes one topic - one complex table (Fig. 1).

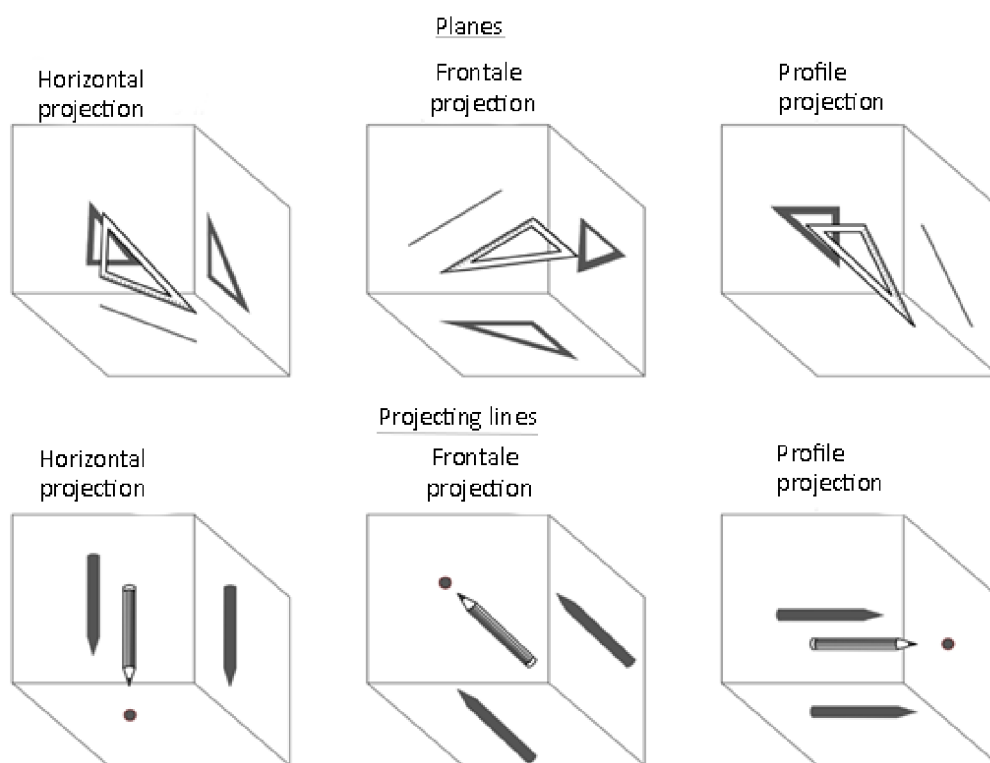


Fig. 1 Planes and projecting lines

Work with complex tables showed that in the lecture it is advisable to use no more than two tables per lecture, in contrast to practical classes, where the amount of visual material can be much greater. The conclusion from the use of generalized tables on engineering graphics is search-heuristic training, which has received reliable tools [10].

As practice has shown, a visual materials is useful in preparing for exams, when you need to look at the course of engineering graphics, as if in general, as it allows you to summarize a large theoretical material. A modern problem in the study of engineering graphics in the first year is that students have some difficulties, because they need developed spatial thinking. Thus, a technique is needed to make learning effective. The use of search-heuristic model of learning allows to some extent to solve this problem [4]. The development of new methods of teaching engineering graphics is especially important right now, when the transition to distance learning is envisaged. For this purpose it is necessary to give out information in blocks. The lecture should take place with the submission of specific materials, as well as with short pauses to switch students' attention. These pauses can take the form of simple puzzles [5]. It should be noted that all the theoretical knowledge needed to solve problems, it is better to give in the learning process as the need arises.

There are topics spread over two or three tables. The practice of working with the audience with the help of tables now suggests how to better use the material. The goal is to focus on topics that are more troubling to students. It is advisable to have a certain methodological novelty in working with complex tables: the student is asked to circle the answers with a red pencil, and the construction lines with green. This can be done if you understand in detail in this comprehensive table. From the point of view of psychology, milestones are formed in the mind, which facilitate the fixation of information in long-term memory (Fig. 2).

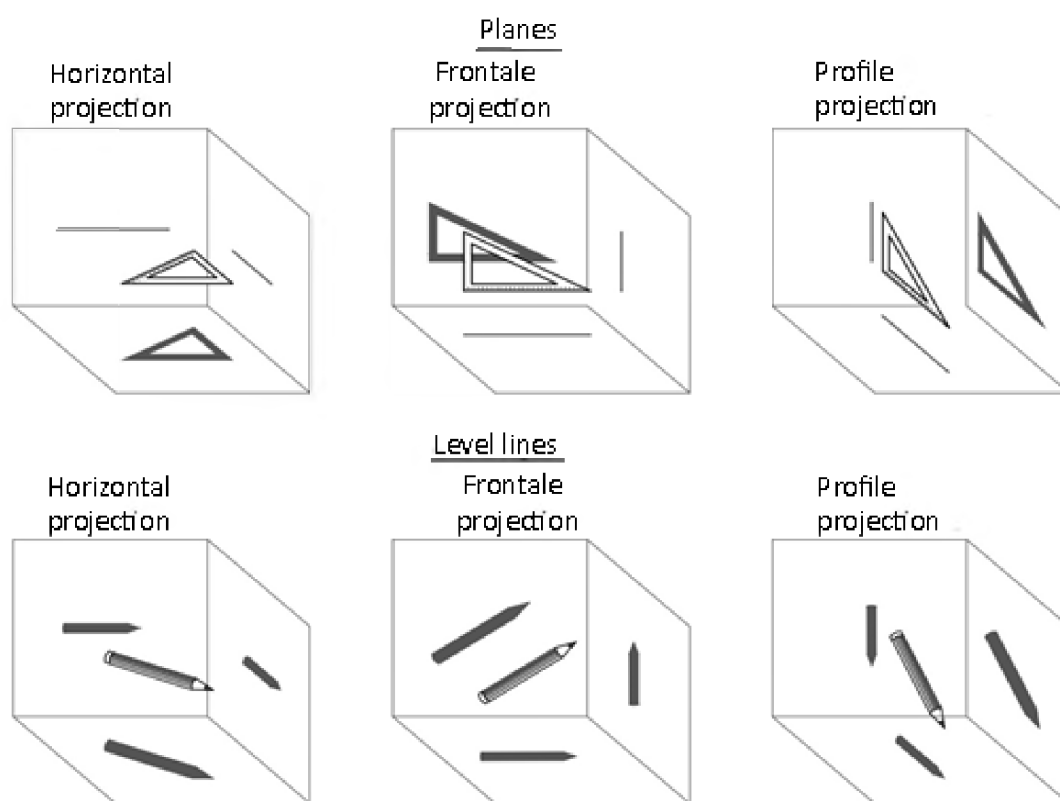


Fig. 2 Planes and level lines

The lecture on engineering graphics should include, in addition to specific information, elements necessary to enable the mechanisms of perception and thinking. It is necessary to have an algorithm of actions with the concrete information which is made on the basis of didactic receptions: dialogue, game situations, and also formation and the decision of problem situations. For example: the didactic receptions to employment on a theme are resulted: «Replacement of the plane of projections». A short methodical comment to it: the task is to draw a general view of a device, where you need to provide a working drawing of the details of this device.

Earlier it was reported that this problem can be solved using the methods of engineering graphics, and which method is not specified. The solution of the problem in front of the audience with the account of the positions of problem-based learning may sound like this: «Suppose we work with you in a factory. The message came that the gutter needs to be replaced». We have to make this gutter, and there is no gutter drawing, only a general drawing. In the drawing, the device is provided in two projections, in other words there are no exact dimensions. Two planes of the general position are drawn on a board. Students are asked to analyze the condition of the problem in terms of engineering graphics. For example, students formulate the following: «The device is two planes of general position and are interconnected, as well as the angle between them. The projections are not projected in full size. How to formulate a problem from the standpoint of engineering graphics?» The analysis of the condition of the problem led the students to the formulation of the problem: «It is necessary to determine the natural quantities of the plane and the angle between them». The teacher addresses the audience: «There are several solutions. Which one will you and I choose?» Until then, the topic: «Rule of a right triangle» was practiced, so students often suggest using this rule. The teacher on the board determines the natural size of the side of the triangle according to the rule of a right triangle, accompanied by a comment: «We see that hard work is expected. Maybe there is an easier option?» «The root of the book - the edge, is a straight line of general position. If it was a projecting line, then on one of the planes of projections the angle would be projected in life size». For example, you can think like

this: there is a plane on which this angle is projected in real size. Then the line of intersection of the triangles must be perpendicular to this plane. Then the condition of the problem will be simpler: «Turn the line of the general position into a projection». The teacher asks the question: «Is it possible to solve this problem by replacing the plane of projections?» The answer is yes. Sometimes students mistakenly offer another option, that to say the line of general position can be designed to a point with one replacement. This figure is a barrier. It is necessary to provide a block of information (four main tasks on this topic or one of them) [8]. Here it is very useful to use generalized tables of theory, the result of these actions - the group's decision. As a rule, students are offered more options for solving the second part of the problem, which are also analyzed.

The given variant - working off of a theme: «Replacement of the plane of projections» taking into account search-heuristic model of training is not final. The analysis of conducting classes using two models: explanatory-informational model of learning and search-heuristic showed that learning with the help of search-heuristic model of learning is definitely more productive. The development of new methods of teaching engineering graphics is especially important now, when the transition to distance learning is envisaged.

Conclusion. From the use of generalized tables in the academic discipline of engineering graphics - is a search and heuristic training. As practice has shown, the use of generalized tables of the theory of engineering graphics is useful in preparing for exams, when you need to look at the course of engineering graphics, as if in general, as it allows you to summarize a large theoretical material. Due to the introduction of this method, students' spatial thinking develops faster. The initiated method makes it possible to create a direction for the disclosure of the following necessary solutions to problems in descriptive geometry.

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КОМПЛЕКСНІ ТАБЛИЦІ «ТЕОРІЇ ІНЖЕНЕРНОЇ ГРАФІКИ» І ЇХ ВИКОРИСТАННЯ В НАВЧАННІ ЗА СПЕЦІАЛЬНІСТЮ 191 АРХІТЕКТУРА ТА МІСТОБУДУВАННЯ

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Анотація. Лекції з інженерної графіки, для студентів архітектурних спеціальностей, згідно навчальних програм потребують значну кількість наочних матеріалів. Доцільно передати теоретичні положення інженерної графіки у вигляді таблиці. Такий підхід дає змогу структурувати матеріал лекцій у вигляді комплексних таблиць теорії, зробивши основний наголос на зображеннях. Теоретичний матеріал у вигляді комплексних таблиць дозволяє більш вдало використовувати пошуково-евристичне навчання, що доцільно, тому що в школах креслення зараз майже нема. Подібні методики передбачають розгляд відразу декількох підходів до вирішення завдань і в цілому багатоваріантність викладу всього курсу лекцій з інженерної графіки, що можна здійснити за допомогою узагальнених таблиць теорії. Так наприклад, чотири основні завдання нарисної геометрії, які вирішуються трьома способами перетворення епора, надані на одному аркуші. Нарисна геометрія-граматика інженерної графіки готує студента висловлювати свої думки за допомогою креслень і розуміти думки інших у вигляді креслень.

Ключові слова: інженерна графіка, структура, пошуково-евристичне навчання, геометрія-граматика.

КОМПЛЕКСНЫЕ ТАБЛИЦЫ «ТЕОРИИ ИНЖЕНЕРНОЙ ГРАФИКИ» И ИХ ИСПОЛЬЗОВАНИЕ В ОБУЧЕНИИ ПО СПЕЦИАЛЬНОСТИ 191 АРХИТЕКТУРА И ГРАДОСТРОИТЕЛЬСТВО

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Аннотация. Лекции по инженерной графике, для студентов архитектурных специальностей, согласно учебных программ требует значительное количество наглядных материалов. Целесообразно предложить теоретические положения инженерной графики в виде таблицы. Такой подход позволяет структурировать материал лекций в виде комплексных таблиц теории, сделав основной упор на изображениях. Теоретический материал в виде комплексных таблиц позволяет более удачно использовать поисково-эвристическое обучения, целесообразно, так как в школах чертежи сейчас почти нет. Подобные методики предусматривают рассмотрение сразу нескольких подходов к

решению задач и в целом много вариантность изложения всего курса лекций по инженерной графики, можно осуществить с помощью обобщенных таблиц теории. Например, четыре основные задачи начертательной геометрии, которые решаются тремя способами преобразования эпюра, предоставленные на одном листе. Начертательная геометрия-грамматика инженерной графики готовит студента выражать свои мысли с помощью чертежей и понимать других в виде чертежей.

Ключевые слова: инженерная графика, структура, поисково-эвристическое обучение, геометрия-грамматика.