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ROLE OF COMPUTER EDUCATIONAL TECHNOLOGIES IN PROVIDING HARMONIZATION IN THEORY AND PRACTICE (ON THE EXAMPLE OF THE SUBJECT "RESISTANCE OF MATERIALS")

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ABSTRACT

The article describes an innovative method for the simultaneous calculation of the strength and stiffness of rods and shafts by the method of initial parameters. Universal formulas for tension, compression and torsion of the beams are derived, as well as the effectiveness in education of using the MathCAD program in the calculation and design of structural elements is substantiated.

KEYWORDS: *Learning Technologies, Student-Centered Learning Technologies, Computerized Learning Technologies, Practical Skills And Qualifications, Competence, Timber, Strength, Rigidity, Diagram, Internal Efforts, Elastic Mixing, Guaranteed Result.*

INTRODUCTION

Decree of the President of the Republic of Uzbekistan No. PF-5847 of October 8, 2019 "On the Concept of Development of the Higher Education System of the Republic of Uzbekistan until 2030" the urgency of ensuring the compatibility of theory and practice in providing education with innovative and information and communication technology methodologies in order to "…ensuring strong integration of modern information and communication technologies and educational technologies, creating additional conditions for the continuous development of professional skills of teachers in this area" is aimed at the formation and improvement of a competitive economy **[1].**

In engineering practice, the process of testing concrete beams (beams, rods, shafts) for strength and durability at the same time and obtaining accurate design solutions is the main goal of the science of "Material Resistance". In these days of rapid development of science and rapid growth and frequent updating of scientific and technical information, improvement of engineering structures and technological processes, increasing the level of automation in management systems, the transition to a system of training at the undergraduate academic level problems occur. In fact, these problems are due to the fact that the amount of workload allocated to the student is significantly reduced compared to previous years.

The second aspect of the problem is that compliance with the requirements of the State Education Standards must be unconditionally ensured. The only way to solve such scientific and pedagogical problems is the introduction of person-centered educational technologies in the educational process, which is one of the most pressing tasks in educational practice. At the same time, in the era of rapidly accelerating globalization in the international labor market - high technology, mass information, digitalization in real sectors of the economy, the flow of information is rapidly entering social life in our country and is widespread. One of the most pressing issues facing the education system is the rapid receipt of information, its analysis, processing, synthesis, summarization and, ultimately, the achievement of guaranteed results in education by referring to

the judgment of students. Naturally, such a comprehensive, goal-oriented process requires the technologicalization of the educational process.

Although the use of person-centered innovative technologies reduces the workload, while maintaining the integrity of the content and quality of education, the educational process will be significantly accelerated in accordance with the requirements of the time, and efforts will be aimed at achieving guaranteed results. The essence of the technology of person-centered education is that it takes into account the interests of all participants in the educational process - the full development. This, of course, when planning the educational process in advance, of course, is the competence of one individual participant in the process - not to improve the knowledge and practical skills of the individual, but to develop the knowledge and practical skills of all participants. it is also necessary to take into account the need to take the symptoms to a higher level. Therefore, in the organization and implementation of educational processes in the discipline of "Resistance of Materials" it is expedient to use the types of person-centered education: modular, computerized, interactive, problem-based, innovative, independent and distance learning technologies. Now, we will briefly describe the main aspects of computerized learning technology, which is widely used in the system of continuing education **[2].**

In general, computerized learning technology is a type of education based on the direct use of computer technology in practice, which is an integral part of new information and information technologies. Computerized educational technology has the ability to optimally manage the educational process, the active participation of the individual student in the solution of the problem in individual or pedagogical cooperation (teacher-student interaction), the possibility of repeating the educational cycle if necessary, pedagogical and psychological convenience. The convenience, efficiency and effectiveness of this technology depends primarily on the level of preparation of didactic software. In addition, the level of organization and implementation of the educational process and educational institutions will depend on such factors as the ability, potential, attitude of the participants of pedagogical cooperation to the process. The professionalism of the teacher, who sets the goal of achieving a guaranteed result in education, is felt primarily in the process of planning educational processes.

The correct choice of pedagogical technology and pre-design of the educational process is one of the main criteria for achieving a guaranteed result. Therefore, in order for a teacher to correctly design the educational process, he must first be able to see the course of the lesson as a whole and be able to fully imagine it. From this point of view, the educator should take appropriate scientific guidelines that directly affect the content, quality and effectiveness of education in order to further improve the methodology of practical and vocational education, aimed at strengthening the content of the practical textbook or facilitating the process. It is advisable to develop documents. In general education and general professional disciplines, it is necessary to create a training algorithm for the subject "Resistance of materials" on the basis of practical teaching methods in order to organize the process in a systematic, consistent manner. This approach is used in solving problems identified in science programs, the main purpose of which is to increase the effectiveness of rapid logical thinking, as well as the formation of practical skills and abilities of students. In the same way, if an algorithm is developed for conducting experiments in the laboratory, logical thinking will be further developed in the process of obtaining experimental results and summarizing them. Learning algorithms are not created in a single "template", the essence of which depends on the research topic of science and the correct choice of research methods (methods or techniques) for its implementation. It is also possible to develop algorithms (technological-guided maps) for each lesson, even for a specific topic, based on the characteristics of the science and innovative technology that is intended for direct application in education.

This is because the process of practical work during the training is carried out on the basis of the sequence rule specified in the algorithm. Whatever the structure of the learning algorithm, it must

reflect the educational process as a whole in a clear and understandable way, more precisely, it must take into account the educational trio in the form of "Goal - process (tool) - guaranteed result." Based on this scientific idea, the MathCAD program is designed for students to determine the shear forces and bending moments caused by the bending of beams under the influence of external forces in the calculation of graphic work in the field of "Resistance of Materials" as part of practical training and independent study. On the basis of the methodological component - a model of a standard training algorithm for practical training was created **[3].**

Based on the model, directly using MS Excel and Mathcad computational programs, practical problems such as checking the beams for strength at normal and shear stresses in general, as well as determining the linear and angular displacements and accurate assessment of virginity are also solved. An analysis of the technical literature confirms that in most textbooks "Material Resistance" or manuals "Method of initial parameters" is applied only to the process of bending beams. It should be noted that this method is designed for the design of fixed beams, the basis of which is a universal formula **[4].**

The main purpose of this article is to solve the problem of simultaneously calculating the strength and stiffness of both rods and shafts using the method of initial parameters, with an innovative approach to education. Given that the use of MathCad in computational work based on this method is much more effective in education, the author has adapted universal formulas for beams that work on elongation, compression and torsion. Accordingly, the practical application of universal formulas should be based on the following basic rules:

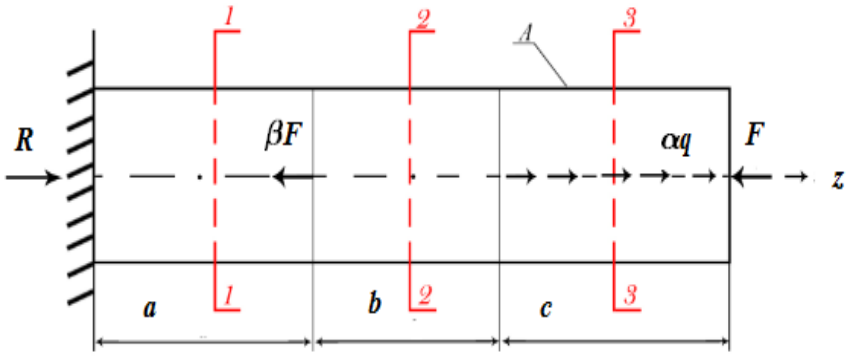
- the coordinate head is always selected from the left end of the beam, and it is common to all intervals (problem solving starts from the left and continues to the right, which the MathCad calculation program works on the same basis);
- expressions of stresses are formed for the left side of the shear;
- while the problem-solving process continues from left to right, if the evenly distributed load (q = *const*) does not reach the end of the beam, it is "artificially" continued. However, in order not to disturb the initial balance of the beam, the intensity is equal to q, but the load in the opposite direction is placed on it at the appropriate distance.

According to the principle of non-interference of forces, a universal formula for determining the elastic displacement for *"n"* intervals (simple, easy to use, taking into account the effects of all external forces, easy to remember) is expressed in the following form:

$$u(z) = u_0 + \frac{1}{EA}F_0\,z + \frac{1}{EA}\sum_{i=1}^{n}F_i\,(z-a_i) + \frac{1}{2EA}\sum_{i=1}^{n}q_i\,(z-b_i)^2 - \frac{1}{2EA}\sum_{i=1}^{n}q_i\,(z-c_i)^2$$

Here, F_0, q_0 – are the accumulated and propagating forces at the origin; a, b, c –are the distances from the origin to the intersections where the concentrated forces and propagating forces are applied, respectively; u_0 –is the displacement of the center of gravity at the beginning of the coordinate, which is found from the boundary conditions.Typically, F_0 and $u_0$are referred to as the initial parameters. We will now describe a methodology for solving the problem of central elongation and compression of rods. Suppose that a force made of steel material and consisting of three spaces is influenced by the force propagating and the accumulated forces on a fixed rod

(Fig. 1).



Figure– 1

Given parameters:

$$\alpha := 2 \quad \beta := 3 \quad A := 8\cdot 10^{-4} \quad E := 2\cdot 10^{11} \quad F := 4\cdot 10^{4} \quad q := 2\cdot 10^{4}$$

$$k := (A\cdot E)^{-1} \quad a := 2 \quad b := 1 \quad c := 3 \quad \iota 2 := a + b \quad \iota := a + b + c$$

Note: Strength ***N***, modulus of elasticity N/m^2, and geometric dimensions are measured in ***m***. Using MathCAD software, it is required to construct diagrams of longitudinal force and elastic displacements.

PROBLEM SOLVING METHODOLOGY

1.Static analysis

We first replace the clamped base with an ***R*** reaction. To determine this reaction, we use the ***root*** calculation block, defining the ***Given*** operator. To do this, in the first approximation, the reaction must be equal to an arbitrary constant:

$$Given \qquad R := 10$$

$$R - \beta\cdot F + \alpha\cdot q\cdot c - F = 0$$

$$R := root(R - \beta\cdot F + \alpha\cdot q\cdot c - F, R) \qquad R = 4\times 10^{4}$$

$$R := Find(R) \qquad R = 4\times 10^{4}$$

Now, using the "Methodof Section", we construct the expressions of the internal stress-longitudinal force for three intervals and use the ***if*** operator:

$$N(z) := \begin{cases} -R & if\ 0 \le z \le a \\ -R + \beta\cdot F & if\ a \le z \le \iota 2 \\ -R + \beta\cdot F - \alpha\cdot q\cdot[z - (a + b)] & if\ \iota 2 \le z \le \iota \end{cases}$$

2. Deformation analysis.

We formulate a universal formula for determining migration. The initial parameters are as follows:$N(0) = F_0 = R,\ u(0) = 0$.

1-1:	$Fo := -R$	$uo := 0$	$qo := 0$
2-2:	$Fi := \beta \cdot F$	$ai := a$	$qi := 0$
3-3:	$Fi := 0$	$qi := -\alpha \cdot q$	$bi := \iota 2$

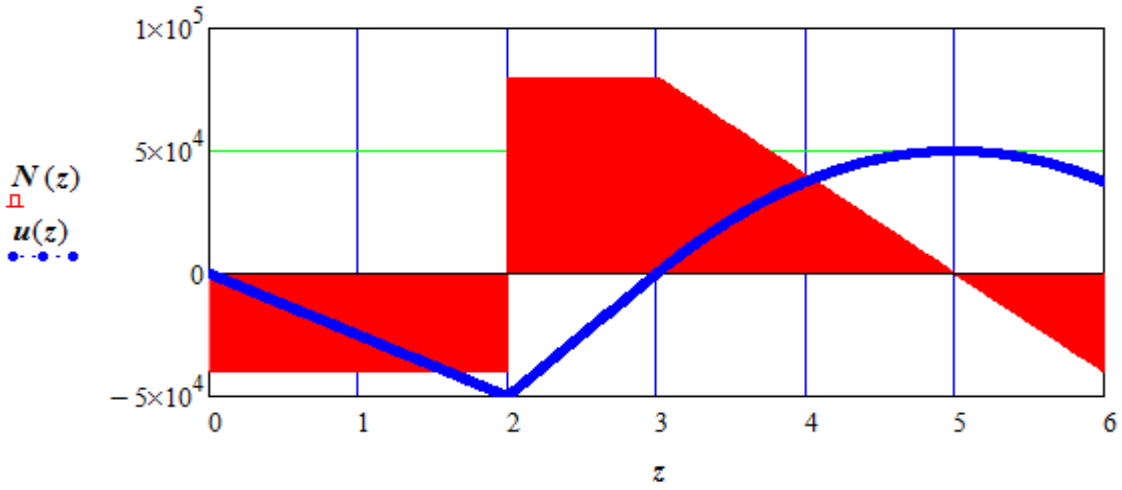
As a result, we have:

$$u(z) := \begin{cases} k \cdot (-R) \cdot z & \text{if } 0 \le z \le a \\ k \cdot [(-R) \cdot z + \beta \cdot F \cdot (z - a)] & \text{if } a \le z \le \iota 2 \\ k \cdot \left[(-R) \cdot z + \beta \cdot F \cdot (z - a) + \frac{1}{2} \cdot (-\alpha \cdot q) \cdot (z - \iota 2)^2 \right] & \text{if } \iota 2 \le z \le \iota \end{cases}$$

3. Graphic analysis.

Using the Graph menu, enter the following "compatibility coefficient" in order to place a diagram of two parameters in the same coordinate plane:

$$\underline{u}(z) := 10^8 \cdot u(z) \qquad z := 0, \frac{(a+b+c)}{777} .. (a+b+c)$$



To determine the true value of elastic displacement, it is sufficient to use the following relationship:

$$\underline{u}(z) := 10^{-8} \cdot u(z) \qquad z := 0, \frac{\iota}{6} .. \iota$$

$z =$	$N(z) =$	$u(z) =$
0	$-4 \cdot 10^4$	0
1	$-4 \cdot 10^4$	$-2.5 \cdot 10^{-4}$
2	$8 \cdot 10^4$	$-5 \cdot 10^{-4}$
3	$8 \cdot 10^4$	0
4	$4 \cdot 10^4$	$3.75 \cdot 10^{-4}$
5	0	$5 \cdot 10^{-4}$
6	$-4 \cdot 10^4$	$3.75 \cdot 10^{-4}$

CONCLUSIONS

In solving problems using Mathcad software within the framework of computerized learning technology, based on the above methodology:

• Be able to solve problems very quickly with less time for students;

• Get accurate and error-free results with very high accuracy;

• In the process of solving problems, students' theoretical knowledge and practical skills are combined; as a result, the possibility of simultaneously calculating the strength and stiffness of the beams, which have two or more intervals in independent training and resist complex loads (simultaneously under the influence of accumulated force, propagating force and double forces);

• Due to the possibility of using special standard programs in the construction of diagrams of internal forces, stresses and deformations or displacements, students' time is not wasted on arithmetic calculations or construction of diagrams, but their time and opportunities are directed directly to creative, analytical-critical and coherent approaches;

• The obtained practical results confirm the advantages, such as the breadth of opportunities to create a new generation of textbooks in general engineering and improve the methodology of their use in educational practice.

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