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The Importance of Physical Exercises in the Training of Specialists in the Field of Architecture and Construction

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Abstract. The article discusses the methodological features of the teaching process of physics in higher education institutions in the field of construction. Given the introduction of a credit-module system in the educational process, the role of physics in the training of future civil engineers and its integration with other special general engineering disciplines is discussed. There are guidelines and recommendations for the effective organization of the teaching process and independent learning.

Keywords: credit-module, physics, training, interdisciplinary integration, inertial damper, buildings and structures, vibrations, construction, career guidance, civil engineer.

INTRODUCTION

In today's world of market-based economic systems, there is a growing demand for people with broad, in-depth knowledge and the ability to put knowledge into practice. An educated and enterprising person, a socially active person finds his place in the life of society, in work. To do this, the organization of education must take into account the professional abilities, needs and peculiarities of the student. Theoretical issues of teaching "General Physics" are one of the most important issues in the training of specialists in the field of construction.

According to the Resolution of the President of the Republic of Uzbekistan dated March 19, 2021 "On measures to improve the quality of education in physics and the development of scientific research" from the 2021/2022 academic year to increase the teaching of physics in higher education The issue of implementation has been identified. Therefore, in order to ensure the implementation of the tasks set out in this resolution, the authors pay special attention to the direct application of the topics of lectures, practical and laboratory classes in physics to the field of construction. These aspects are taken into account in the development of science curricula and syllabi.

METHODS

T-scheme, cluster and integration methods can be used to effectively organize classroom activities.

If the advantages and disadvantages of the inertial damper are analyzed on the basis of the "T-scheme", the level of mastery of the subject by students will increase.

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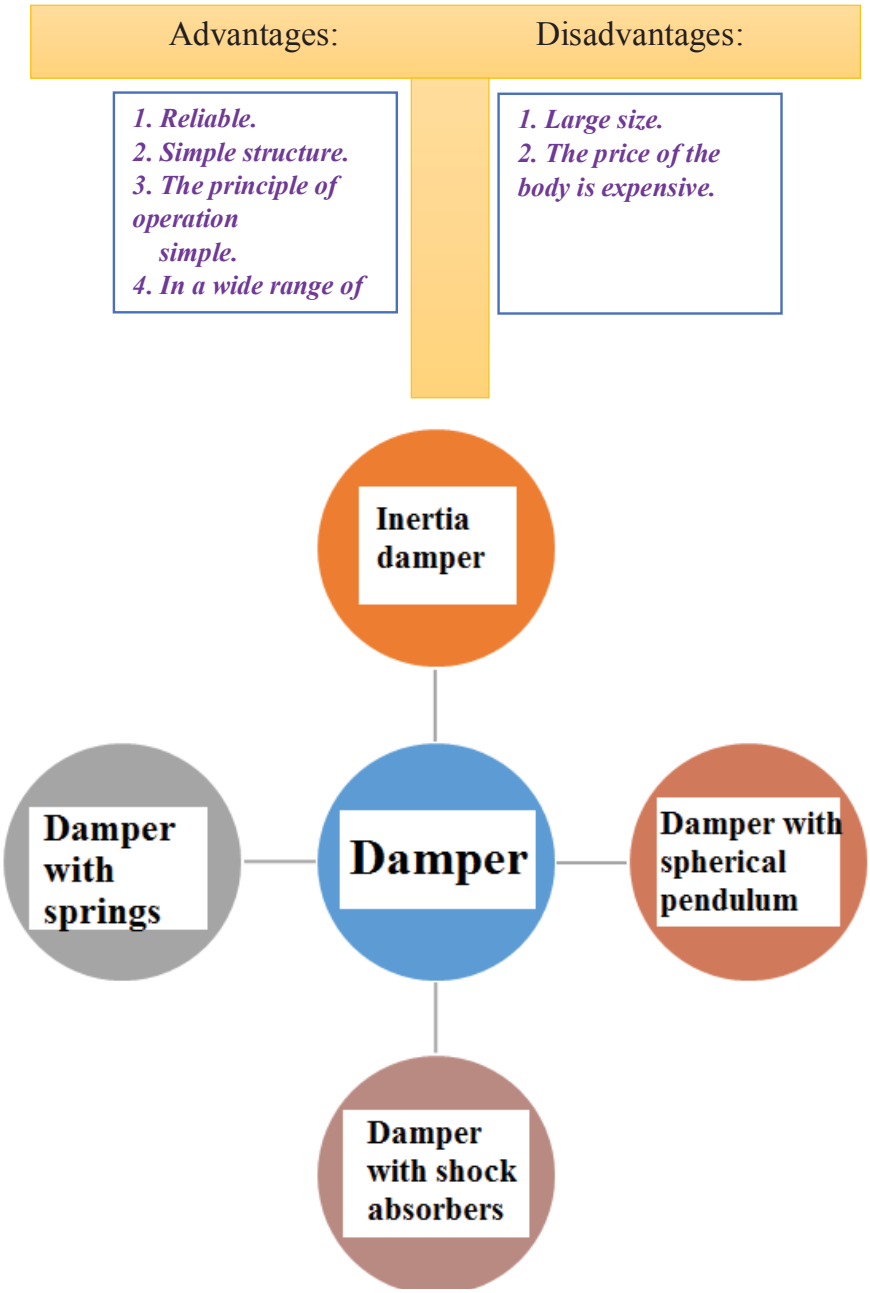

FIGURE 1. Explanation of damper types by the method of "Cluster".

It is known that today many universities have introduced a credit-module system in the educational process. The credit system is a unit of measurement that reflects the results achieved, not the number of hours studied. That is, it is a unit of measurement that measures the level of competence of a specialist. This means that credit is not only an assessment of academic performance, but also a unit that reflects the workload completed. The introduction of a credit-module system is an important factor in the collaboration of faculty and students. In modular education, the teacher organizes, directs, advises and supervises the process of mastering the listener. The student moves independently towards the target object. The emphasis is on students' independent learning. The importance of

independent learning in the learning process will increase, which will lead to an increase in the independence, creative initiative and activity of professionals in the future.

RESULTS AND DISCUSSION

In the credit-module system, the amount of credit allocated for general physics in areas not trained by physicists is 5-7. It turns out that there are more hours for independent study in general physics than for lectures, practical and laboratory classes. This means that a large amount of information needs to be delivered to students in a short period of time. This is due to the fact that the number of hours allocated for classroom training has decreased by an average of 1.6 times. How can this problem be solved? In our opinion, the best way to solve this problem is to organize classroom lessons and independent study correctly and effectively. It is important to consider what the student's future specialization will be. That is, interdisciplinary integration must be ensured. For example, students majoring in Building and Civil Engineering (industrial and civil engineering) will become civil engineers in the future. Students in this field of study are directly related to the science of physics: building mechanics, building materials and products, engineering communications of buildings, wooden structures, metal structures, reinforced concrete and stone structures, building physics and energy efficiency of buildings are required to master subjects such as engineering for 4 years. Knowledge and skills in physics are essential for mastering the above disciplines. Because without knowing the simple laws and laws of physics, it is impossible to explain the physical phenomena and processes that take place in buildings.

The science of building physics and building energy engineering studies the physical processes that take place in a building and its parts, and the effects of these processes on the building and man. That is, on the one hand, it is to create the indoor air temperature and humidity that are suitable for human habitation and certain activities inside the building, and on the other hand, it is to create conditions to ensure long-term service of building parts [1]. There are three types of physical processes that take place in a building and its parts: heat; light and acoustics. Thermal engineering is the study of the movement of heat energy in a building and its parts and the processes of mass transfer consisting of water vapor. Lighting technology is the study of the creation of natural light in buildings and its effect on human activities. Acoustics is the study of the laws governing the propagation of sound waves in a building and its devices. For a thorough study of the Department of Thermal Engineering, the basics of physics: the basics of thermodynamics, reversible and irreversible thermal processes, the laws of thermodynamics, relative and absolute humidity, migration phenomena. , the basic laws of optics, photometric concepts and units, and in the acoustics section: the propagation of oscillating motion in an elastic medium, the equations of flat and spherical waves, the interference and diffraction of waves, stationary waves, sound waves, etc. they are required to be well versed in the topics. For full mastery of disciplines such as reinforced concrete and stone structures, metal structures, wood structures, students in physics - density of materials, types of deformation, elastic forces, mechanical stress, absolute and relative elongation, wool modulus, elongation and compression they must have a good understanding of concepts such as the strength of substances, the coefficient of linear expansion, and quantities. Otherwise, the expected results will not be achieved. Interdisciplinary integration should also focus on the organization of laboratories, workshops and independent learning. For example, in physics, a laboratory exercise called "Determining the acceleration of free fall using a mathematical pendulum" reinforces students' theoretical knowledge in lectures. At the same time, it is possible to provide vocational guidance to students. In the course of this laboratory work, we consider it expedient to provide information on the use of pendulums in earthquake construction in modern buildings. An example of this is the inertial damper used in the 111 West 57th Street building under construction in the United States. It is considered to be the “thinnest skyscraper” (Figure 1), with a height of 438 meters and a width of 18 meters, and is planned to be equipped with an inertial damper weighing 800 tons. This damper is used to balance the building's resistance to earthquakes and wind. The inertial damper consists of two superimposed loads, one of which is suspended from the cable and the other is attached to the base (Figure 2).

FIGURE 2. General view of 111 West 57th Street.

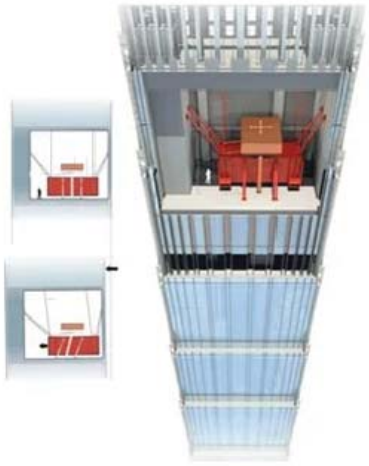

FIGURE 3. The structure of the inertial damper used in the 111 West 57th Street building.

If the building tilts in a certain direction under the influence of external forces (wind or earthquakes), the damper tilts in the opposite direction and due to its weight returns the building to equilibrium and prevents the building from collapsing. .

There are many more such examples. The world's first Taipei 101 building, more than half a kilometer long, used a pendulum with a total weight of 660 tons to withstand typhoons and earthquakes. This pendulum is located on the 87-91st floor of the building, which allows the building to remain in equilibrium even when the wind speed reaches 216 km / h. Inertial dampers have been used not only in skyscrapers but also in buildings. In London, for example, inertial dampers were also used to damp vibrations on a vibrating bridge built in 2000 (Figure 3).

FIGURE 4. View of the Millennium Bridge in London.

A set of specially designed and selected professionally oriented tasks should be used in the practical training in physics [5]. This type of problem is the main practical direction of teaching physics [6].

The following are examples from physics that are directly related to the field of construction:

a). The flat wall is made of a material with thermal conductivity $\lambda = 0{,}25\ W/m \cdot K$. Wall thickness d = 50 mm. The corresponding surface temperatures of the wall are: $T_1 = 50^0C$, $T_2 = 20^0C$. Find the density of heat flux passing through a flat wall [7].

We describe the temperature graph of the thermal conductivity process in a single-layer flat wall (Figure 4).

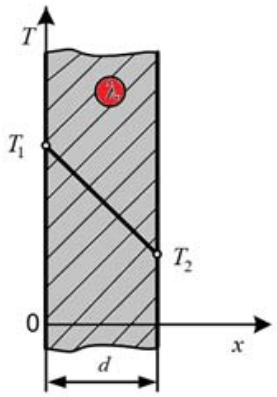

FIGURE 5. Temperature dependence of the thermal conductivity of a single-layer flat wall.

The thermal resistance of a flat single-layer wall is determined as follows

$$R_t = \frac{d}{\lambda} = \frac{0{,}05}{0{,}25} = 0{,}2\ \frac{m^2 \cdot K}{W} \tag{1}$$

The density of heat flux through a flat wall can be found by the following formula,

$$q = \frac{T_1 - T_2}{R_t} = \frac{50 - 20}{0{,}2} = 150\ \frac{W}{m^2} \tag{2}$$

Hence, the heat flux density is $q = 150\ \frac{W}{m^2}$.

b). There is a lamp in the middle of a square room with an area of 25 m^2. At what height does the lamp hang from the floor so that the light in the corners of the room is maximal? [8]

In terms of illumination,

$$E = \frac{I}{r^2}\cos\alpha \tag{3}$$

where, *I*- is the power of the light source, *r*-is the distance from the light source to the corner of the room, α- and a is the angle of incidence of the light. As can be seen from Figure 5, given that $a = r\sin\alpha = \frac{b}{\sqrt{2}} = h\,\mathrm{tg}\,\alpha$

$$E = \frac{I}{a^2}\cos\alpha\, sin^2\alpha \tag{4}$$

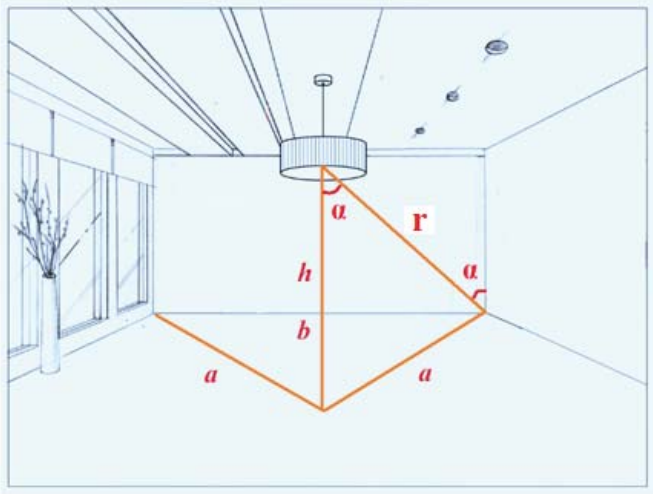

FIGURE 6. The higher the height of the lamp hanging from the floor in the room, the more visible the lighting in the corners of the room will be.

To find the maximum value of illuminance, we derive α from the above expression and divide it by zero,

$$\frac{dE}{d\alpha} = \frac{I}{a^2}(2\cos^2\alpha\, sin\alpha - sin^3\alpha) = 0 \tag{5}$$

Hence, $\mathrm{tg}^2\,\alpha = 2$ and $h = \frac{b}{\sqrt{2}tg\alpha} = \frac{\sqrt{s}}{\sqrt{2}tg\alpha} = 2{,}5\,meters.$ This means that all of the above issues are directly related to the field of construction, which creates the basis for the student's interest in physics.

Physics is studied in depth through lectures, problem-solving in practice classes, and experiments in the laboratory. If a student does not study the lecture material in depth and work independently, he will not have enough knowledge. Given the importance of independent work for students, special attention is paid to independent education in the curricula and state educational standards approved by the Ministry of Higher and Secondary Special Education of the Republic of Uzbekistan. Almost 50% of the study load for physics is devoted to independent study.

Students' independent work should be organized, if possible, using information technology (IT), as well as theoretical, practical, test and control materials, and professionally oriented didactic materials, using guidelines for solving professional problems. This approach to organizing students 'independent work not only helps to improve the quality of students' fundamental knowledge, but also builds their ability to apply the knowledge they have acquired in their later education and future careers. Proper and effective organization of independent work helps to improve the quality of students' fundamental knowledge and the ability to apply their knowledge in the further educational process and in their future careers. To do this, it is necessary to organize independent work with the use of additional materials in the organization of lectures, practical, laboratory classes [9]. We believe that it is advisable to carry out this work in close cooperation between a professor of physics and a professor of special sciences. In general, physics is one of the most important fundamental disciplines in the successful acquisition of specialties by future civil engineers in higher education institutions in the field of construction [10].

CONCLUSION

The above-mentioned physics lectures, practical and laboratory classes will strengthen students' knowledge of physics through examples directly related to the field of construction. In this case, the use of "T-scheme", "Cluster" and "Integration" methods leads to the effective organization of lessons. As a result, future civil engineers understand the close connection between physics and construction, and through this, students are directed to the profession.

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