APPLICATION OF INTEGRAL CALCULUS IN ARCHITECTURE AND CONSTRUCTION.

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ANNOTATION

This work reflects the application of integral calculus to architecture and construction. The purpose of this paper is to explore the possibility of using integrals to solve architectural problems.

Keywords. Architecture and construction, integrals, differential equations, architecture, matrix theory, exact integrals, globalization.

INTRODUCTION

At the same time, economic forces are having a major impact on architecture and construction. The eternal beauty of the shapes, the precision, and the expression of the artistic style are all the achievements of accurate mathematical calculation. The process of globalization is still going on in the world, with national architecture and the economy being important areas.

The task of a modern architect is to make his project effective and harmonious. However, this requires a good knowledge of higher mathematical theory. He should be well versed in the basics of analytic geometry, mathematical analysis, higher algebra, matrix theory, and differential equations. Therefore, in the future, a great deal of attention will be paid to mathematics in the training of specialists in the field of architecture around the world.

Many processes of architecture and construction have been shortened in the form of mathematical modeling, i.e., formulas, in the form of functional dependencies. For example, an integrated account helps computers study architectural models. These factors confirm the importance and relevance of the work done.

MAIN PART

The purpose of this paper is to explore the possibility of using integrals to solve architectural problems.

An architect with a high level of mathematical knowledge can solve the following sequence of tasks, for example:

-find a single variable when resizing parts and determine the relationship between the parameters (decrease or increase);

-determine the location of the space used to place the structures;

-distinguish a certain object from other structures, which allows to describe it mathematically;

-design structures and their surroundings using mathematical principles.

The topic of this work will always be relevant, as mathematical methods are used in many areas of life, including construction.

Issue 1.A labor productivity$f(t) = -3t^2 + 18t$if determined by the function, determine the amount of building materials produced by the workers. Find production during working hours: 1) in one working day: 2) for the third hour of work; 3) for the last working hour (working time 6 hours); 4) economic analysis of the problem. [1]

Solution. If the continuous function f (t) determines the cocktail productivity, then the workers in the time interval t_1 to t_2, depending on the time t, are represented by the following formula:

$$V = \int_{t_1}^{t_2} f(t)dt.$$

We have

$$f(t) = -3t^2 + 18t.$$

1.We determine the production of working time for the whole day.

$$Q = \int_o^T f(t)dt = \int_0^6 (-3t^2 + 18t)dt = (-t^3 + 9t^2)_0^6 = 108$$

2.Let's find the production for the third hour of work:

$$Q = \int_2^3 f(t)dt = \int_2^3 (-3t^2 + 18t)dt = (-t^3 + 9t^2)_2^3 = 26$$

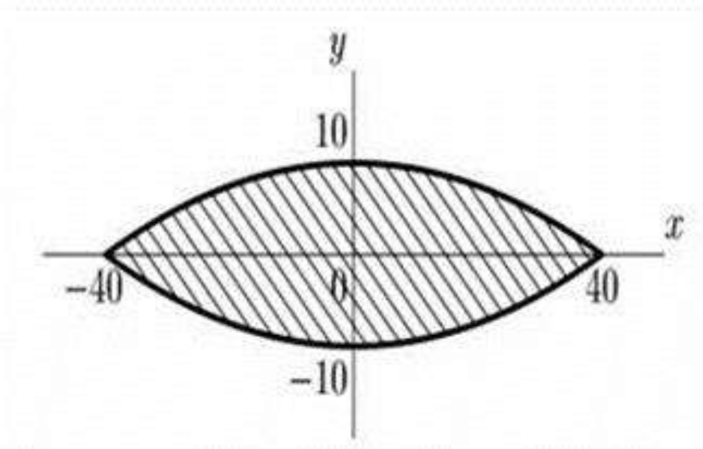
3.Determine the production for the last working hour:

$$Q = \int_5^6 f(t)dt = \int_5^6 (-3t^2 + 18t)dt = (-t^3 + 9t^2)_5^6 = 8$$

4.Economic analysis: work is tiring and requires large volumes. Thus, by the end of the day, the productivity of the cocktail decreases.

Issue 2. The room looks like two intersecting parabolas. How much paint does it take to paint it? The room is 80 m long, 20 m wide in the center and 0.25 kg of paint per square meter. [1,3]

Solution. Introduce a coordinate system along the x-axis and place the origin in the center of the room:



To find the area of a room, we determine the equation of one of the parabolas. The general equation of a parabola: $y = ax^2 + bx + c$. (-40;0), (40;0), (0;10) the points belong to the parabola, so the following system is formed. We find its solutions:

$$\begin{cases} 40a^2 + 40b + c = 0 \\ 40a^2 - 40b + c = 0 \\ c = 10 \end{cases}$$ in this, $a = -\frac{1}{160}, b = 0, c = 10.$

Therefore, the required parabolic equation looks like this:

$$y = -\frac{1}{160}x^2 + 10$$

The face of half the room

$$S = \int_{-40}^{40} \left(-\frac{1}{160}x^2 + 10\right) dx = 2\int_0^{40} \left(-\frac{1}{160}x^2 + 10\right) dx = \frac{1600}{3}$$

You need to paint half the room$0{,}25S = \frac{400}{3}(kg)$I need some paint. The whole room needs to be painted, that's why$2 * 0{,}25S = 2 * \frac{400}{3} \approx 266{,}3\ (kg)$.

Issue 2. The constant cash flow for the construction of the plant is set at an annual interest rate p = 5% for 20 years, with the construction rate:

$$I(t) = -t^2 + 20t + 5.$$

It is necessary to find the current value of this current. According to the formula we have a flow: [2]

$$\Pi = \int_0^{20} (-t^2 + 20t + 5)e^{-0{,}05t}dt$$

Let's replace the variables:

$$S = -0{,}05t, t = -20S, dt = -20dS.$$

The new boundaries of the integral are the old boundaries$S_0 = 0, S_1 = -1$. So we get:

$$\Pi = -20\int_0^{-1} (-400s^2 + 400s + 5)e^x ds = 20\int_{-1}^{0} (-400s^2 + 400s + 5)e^x ds$$

With that in mind, we apply the integral formula to the last integral

$$u = -400s^2 - 400s + 5, du = (-800s - 400)ds, dv = e^s ds, v = e^s$$

Therefore:

$$\Pi = 20e^x(-400s^2 - 400s + 5)_{-1}^{0} + \int_{-1}^{0} e^x(800s + 400)ds$$

We use fractional integration formulas.

$$u = 800s + 400, \qquad du = 800ds$$

We have

$$\Pi = 20(5 - 5e^{-1} + (800s + 400)e^x)_{-1}^{0} + \int_{-1}^{0} 800e^x ds =$$

$$= 20(5 - 5e - 1 + 400 + (800 - 400)e - 1 - 800 + 800e - 1) =$$

$$= 20(1195e - 396)$$

Thus, it should be noted that construction and the economy are closely linked. The search for rational options and directions in the field of architecture and urban planning is very important for the architectural economy. Therefore, the formation of architecture can be trusted in a sense, as well as the creation of economy and economic value.

Integrals are used not only in economics, but also in solving economic problems.

The examples discussed in this article provide clear information about the importance of integrals in solving practical problems. Thus, examples of practical tasks in the field of construction and architecture were solved using a clear integral.

Thus, with the help of integral calculus, the architect is ready to calculate the lengths of graphs, areas and volumes of geometric shapes.

This work provides a better understanding and systematization of integral calculus and allows it to be applied in various fields of science, namely in the field of architecture and construction.

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