

## AUTOMATION OF ENGINEERING CALCULATIONS IN THE PTC MATHCAD PRIME ENVIRONMENT

**Prishluyk M.V., Shershen D.O.**, students of gr. CCE-103

*Scientific adviser – Vashpanov Yu., Dr. of Sciences, PhD, professor, Brain Korea 21 professor, academician of the Academy of Metrology of Ukraine (Department of Physics, Odesa State Academy of Civil Engineering and Architecture)*

**Abstract.** The new PTC Mathcad prime package for performing complex mathematical calculations and solving engineering problems is reviewed. The program significantly speeds up the process of engineering calculations in almost any area of modern engineering. Two samples are considered in the article.

**Introduction.** PTC Mathcad Prime allows you to solve complex engineering problems using artificial intelligence technologies, analyze, document and share engineering calculations. Comprehensive yet intuitive, PTC Mathcad Prime performs the most accurate calculations available today, protects intellectual property, and allows the engineer to demonstrate their engineering work at the highest level [1, 2].

### **Advantages of PTC Mathcad prime:**

1. **Mathematical notation:** Any engineer can very quickly master Mathcad syntax with knowledge of university mathematics. PTC Mathcad Prime contains all the fundamental physical constants and reference data, which makes it convenient for engineering calculations;
2. **Automatic unit processing:** Engineering calculations are carried out using units of measurement, which is very important for checking the correctness of calculations;
3. **New document processing options:** Firstly, the program provides the ability to write text and computational parts in a single document.

**The impact of Mathcad in civil engineering.** In the construction industry, Mathcad is a valuable tool used by engineers to design and analyze key infrastructure, including highways, canals, sewers, bridges, high-rise buildings, sewage treatment plants and dams.

It is used to calculate strains and stresses, bending moments, seismic and wind loads, beam analysis, radiative heat transfer, heating and cooling loads, earth structures and composite profile properties.

**PTC Mathcad Prime.** MathCad Prime has a feature that simplifies the conversion of units between different systems and helps to identify errors in units of measurement made in calculations. Graphs, arrays, and functions are all auxiliary units. Here are some of the measurements that PTC Mathcad Prime can work with.

### **Sample 1.**

The solution to the problem of units of measurement. The following values are given:

- Depth of rectangular channel section = 2.5 m;
- Width of rectangular channel section  $B = 1.4$  m;
- Water consumption  $Q = 100$  m<sup>3</sup>/s;
- Initial height  $H_0 = 2.47$  m;
- Gravity acceleration  $g = 9.807$  m/s<sup>2</sup>.

Need to find: an unknown quantity ( $x$ ), which represents the height of the water in the canal after covering a certain distance.

We solve the entire problem in PTC Mathcad prime in a matter of minutes:

$$P := 2.5 \text{ m} \quad B := 14 \text{ m} \quad Q := 100 \frac{\text{m}^3}{\text{s}} \quad H_0 := 2.47 \text{ m} \quad g = 9.807 \frac{\text{m}}{\text{s}^2}$$

$$Sol := x + \frac{Q^2}{2 \cdot g \cdot x^2 \cdot B^2} - P - H_0 \xrightarrow{\text{solve}, x}$$

$$1.6566666666666667 \cdot m + (4.5467 \dots)$$

$$1.6566666666666667 \cdot m + (-0.5 + 0.86602540378443 \dots)$$

$$1.6566666666666667 \cdot m - (0.5 + 0.86602540378443 \dots)$$

$$Sol = \begin{bmatrix} 4.86 + 5.551i \cdot 10^{-17} \\ -0.679 - 2.22i \cdot 10^{-16} \\ 0.789 + 2.22i \cdot 10^{-16} \end{bmatrix} m \quad Sol := Re(Sol) = \begin{bmatrix} 4.86 \\ -0.679 \\ 0.789 \end{bmatrix} m$$

As you can see, the program itself solved the problem for us, we just need to enter the data and the correct formulas and the answer will be received in a minute.

**Artificial Intelligence in Mathcad Prime.** Artificial Intelligence It performs a number of useful functions that facilitate engineering calculations and analysis. Here are some of them:

1. **Advanced Math Capabilities.** Mathcad Prime offers an expanded set of mathematical symbols and operations that allow you to describe mathematical models more accurately and in more detail;
2. **Work with large amounts of data.** One of the main differences between Mathcad Prime and the regular version of Mathcad is the ability to work with large amounts of data. The limits for data input and processing are much greater in Mathcad Prime than in the basic version;
3. **Improved Math Tools.** Mathcad Prime offers additional math features and tools that make it more versatile and flexible for professionals. With its help, you can solve more complex problems and perform more accurate calculations.

**Sample 2.** Using the artificial intelligence module.

Calculating a complex integral takes a professional mathematician several hours. PTC Mathcad Prime calculates in 2 seconds!

$$\int \frac{(x+2) \cdot (4 \cdot x^2 + 16 \cdot x + 13)}{(2 \cdot x + 1) \cdot (4 \cdot x + 5)^2} dx \rightarrow \frac{\ln(4 \cdot x + 5) - (4 \cdot \ln(2 \cdot x + 1) + x)}{8} - \frac{3}{128 \cdot x + 160}$$

**Conclusion.** The program is specially written for engineers, using knowledge of mathematics and physics studied at the university. The program significantly speeds up the process of engineering calculations in almost any area of modern engineering.

### References:

1. PTC Mathcad Prime <https://www.mathcad.com/en>.
2. Engineering Notebook Powered by PTC Mathcad [https://mathcad.com.ua/uploads/documents/Down\\_Pdf/Mathcad\\_Prime\\_3.1\\_Battlecard.pdf](https://mathcad.com.ua/uploads/documents/Down_Pdf/Mathcad_Prime_3.1_Battlecard.pdf).