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**CONSTRUCTION CALCULATOR
СТРОИТЕЛЬНЫЙ КАЛЬКУЛЯТОР**

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Ключевые слова: алгоритм, программные средства, автоматизация, калькулятор, методы программирования, язык макропрограммирования VBA, среда программирования Visual Studio 2013, язык программирования Windows Forms C++.

Abstract. The article discusses the capabilities of the VBA macro programming language and the Windows Forms C++ programming language using the example of the Building Calculator software application. This application is designed to automate the calculation of cost estimates for building materials in the design of residential and office buildings.

Аннотация. В статье рассмотрены возможности языка макропрограммирования VBA и языка программирования Windows Forms C++ на примере

программного приложения «Строительный калькулятор». Это приложение предназначено для автоматизации расчета сметы расходов на строительные материалы при проектировании жилых и административных зданий.

In accordance with the Decree of the President of the Republic of Belarus dated February 25, 2020 No. 70 "On the development of the agro-industrial complex of the Vitebsk region" [1], young specialists who received full-time education at the expense of public funds, as well as on the basis of targeted training, are provided with certain social support measures, a key role among which is the provision of housing and the possibility of building personal housing on concessional lending terms. These measures are aimed at attracting and retaining qualified employees in farms and organizations of the agro-industrial complex.

The purpose of this work is to create a simple and easy-to-use software application "Construction Calculator", with the help of which it is possible to automate the calculation of a preliminary estimate costs for building materials in the design of residential (and office) buildings. The application should provide the user with the following capabilities [2]:

- selection of the calculation object;
- input of initial data - object parameters;
- selection of the type of building material or components;
- calculation of the consumption of building materials of the selected type,
- calculation of the cost of building materials,
- obtaining the result in the required measurement systems.

The subject of research is programming systems for creating automated applications with a graphical interface for calculations according to specified algorithms.

The research toolkit is the "Visual Studio 2013" programming environment, the Windows Forms C ++ programming language and the VBA macro programming language.

The design of the Building Calculator software application was carried out in several stages.

Stage 1. Development of the algorithm and scheme of the application.

The algorithm of the application is a branching structure, each branch of which implements the calculation of a certain indicator of a construction project. The diagram of the application operation algorithm is shown in Figure 1.

Stage 2. Analysis of software products for creating software applications.

Since the application should be simple and easy to use, provide a graphical user interface that allows visualizing the options for building materials under consideration, the Visual Studio 2013 programming environment and the Windows Forms C ++ programming language supporting visual programming methods were used to develop the software interface. To implement the calculations of the estimate elements, constructions of the C ++ language and the macro programming language VBA were used.

Stage 3. Development of the main form of the application.

In accordance with the algorithm of work, after starting the application, the main form with a graphical interface appears (Figure 1). On this form, you can select the direction of calculation: house component, required building materials, type of roof. To do this, select with the mouse pointer the corresponding figure, which is a button, and, as a result, go to the corresponding window-form for calculating the quantity and cost of the required materials. To implement such transitions, the corresponding procedures were written in the C++ language.

The calculation of each of the indicators is based on well-known mathematical formulas implemented in the corresponding program modules-subroutines written in the C++ language. For ease of implementation and scalability, these modules are combined into a single software structure. A fragment of the subroutine for calculating the consumption of materials when designing, for example, a shed roof is shown below.

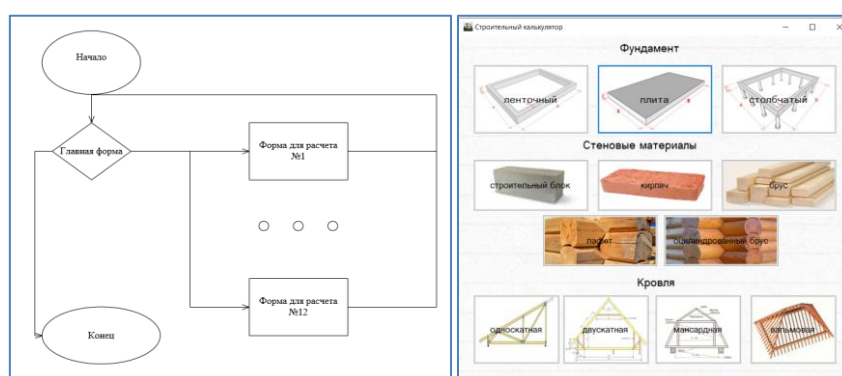


Figure 1 – Scheme of the algorithm and the main form of the application

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if (a <= 0 || b <= 0 || c <= 0 || d <= 0){
    listBox1->Items->Add("Input error ");}
else{ Ds = sqrt(pow(a, 2) + pow(b, 2)); // slope length
    S = c*(Ds + d); // roof area
    Ks = b / 0.7; // number of rafters
    Sr = (0.1 + 0.9) *d;//
    K = S / Sr; // rows on the lathing
    Ss = (0.1 + 0.9) * 6; // lathing area with a board width of 100
mm and a pitch of 90 cm and a long board of 6 m
    Kr = S / Ss; // number of boards for lathing
if (Ds<=0 || S<=0 || Ks<=0 || Ss<=0 || Kr<=0, K<=0)
    {listBox1->Items->Add("Check if the data is correct");}
else
    {listBox1->Items->Add("Roof area "+Convert::ToString(S) + " м2");
    listBox1->Items->Add("Number of rafters" + Convert::ToString(round(Ks)));
    listBox1->Items->Add("A board with a width of 100 mm and a length of 6 m is
used ");
    listBox1->Items->Add("Lathing step 90 cm ");
    
```

```
listBox1->Items->Add("Number of rows per lathing" +  
Convert::ToString(round(K)));  
listBox1->Items->Add("Number of boards per lathing" +  
Convert::ToString(round(Kr)));}
```

Thus, the user only needs to enter the initial data – the estimated parameters of the object, and click the "Calculate" button. This button activates the execution of the corresponding program module, the result of which can be seen in the output window. If necessary, the calculations can be repeated by changing the initial data. To do this, use the "Clear" button.

The developed application is simple and easy to use, has a friendly interface, and does not require any special programming skills. Its versatility lies in the possibility of an initial assessment of the consumption and cost of various combinations of building materials in the design of residential and office buildings. A potential applicant for the construction of his own house, including a young specialist, before contacting a construction organization, using this application can make certain decisions for himself. At the same time, such a construction calculator may, to a certain extent, be in demand in construction companies. However, it is worth noting that any calculator software products are still not professional calculation tools and the calculations performed with their help may have some inaccuracies.

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