USING PLUGINS IN BIM-PROGRAMS WHEN DESIGNING BRIDGE ELEMENTS

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ABSTRACT

The article considers an example of extending the program for information modeling of elements of the metal bridge.

Over just the past few years there has been a significant progress and qualitative leap in design of building structures transforming it from two-dimensional drawings to information modeling (BIM technology). This transition became possible due to modern software. Unlike the creation of two-dimensional drawings and three-dimensional model of the construction in the CAD system, the process of information modeling creates a database that contains information about each element of the building. This approach allows to store and modify information about the object throughout the whole lifecycle of the project.

Revit and Tekla are the most popular products in Russia. With their help it takes little time to assemble an information model for a typical building because these programs contain large libraries with the elements. However, when designing a unique building it is necessary to add new elements and plug-ins (extensions) to the program. Plug-ins can significantly reduce the design time. Almost all of the programs for BIM allow the usage of such extensions.

Tekla has a very convenient functionality for automation. With this program it is possible to extend the functionality using the Tekla Open API, which uses C# programming language.

The article considers the automation process of placing the bolts in the nodes of the main through trusses of the metal bridge. To achieve this, a C# program (plug-in) that performs the placing of the bolts has been created. Examples of dialog boxes created with the help of the Tekla Open API that illustrate the implementation of the proposed algorithm are provided.

Keywords: information model, computer-aided design system, BIM-technologies, Open API interface, adaptation, plug-in, truss, node, bridge.

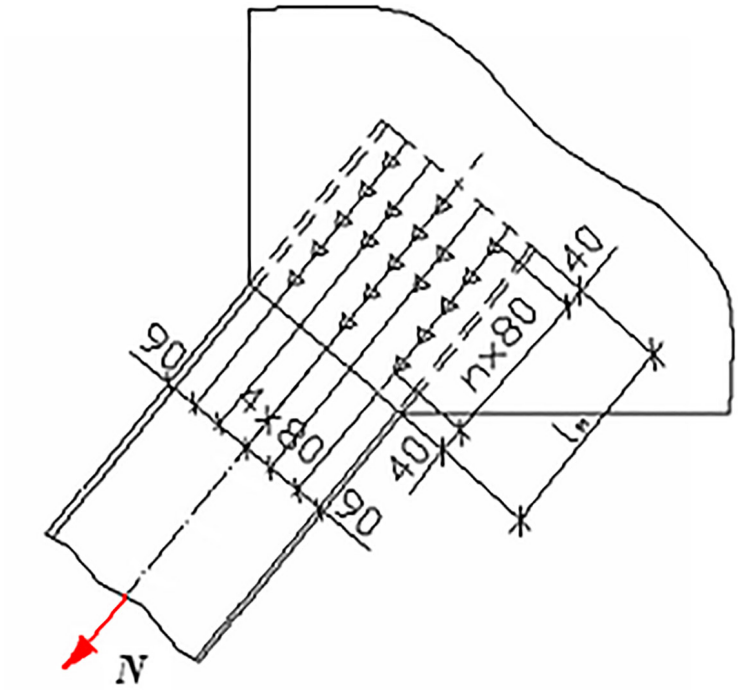
Background. *Unlike the creation of drawings of a design in a graphic program, the process of information modeling creates a database, which contains information on each element of the design. This approach allows to store, use and modify information about the object throughout the entire lifecycle of the structure.*

The most famous programs are Revit (Autodesk), Tekla (Trimble) and Bentley (Bentley). Each of them has its own peculiarities and is oriented to a certain type of structures, but the most accessible ones are Revit and Tekla, which can help to quickly collect an information model of a typical design. However, when designing a unique structure, it is necessary to supplement the program with new elements and plug-ins (extensions). Plugins can significantly reduce the time to create a project. Almost all programs for BIM have the option of such additions.

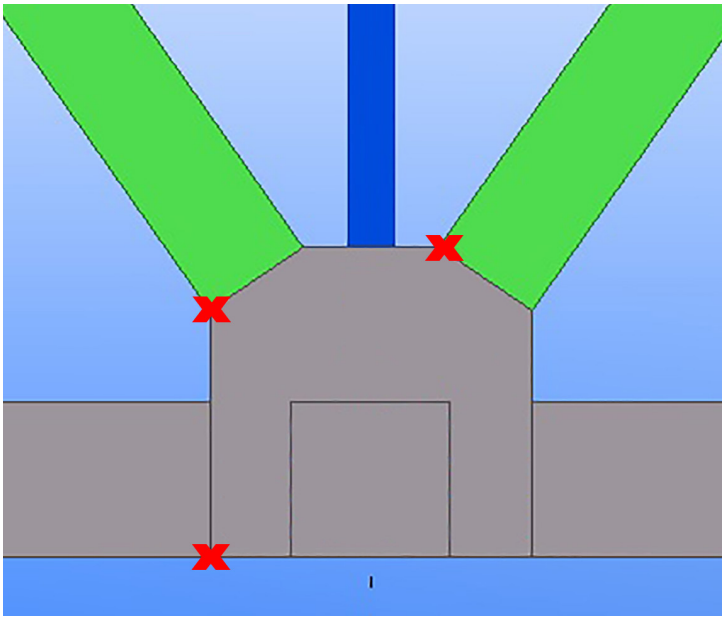
Objective. *The author is to consider plug-ins in BIM-programs when designing bridge elements.*

Methods. *The author uses general scientific and engineering methods, scientific description, modeling, graph construction, computing tools.*

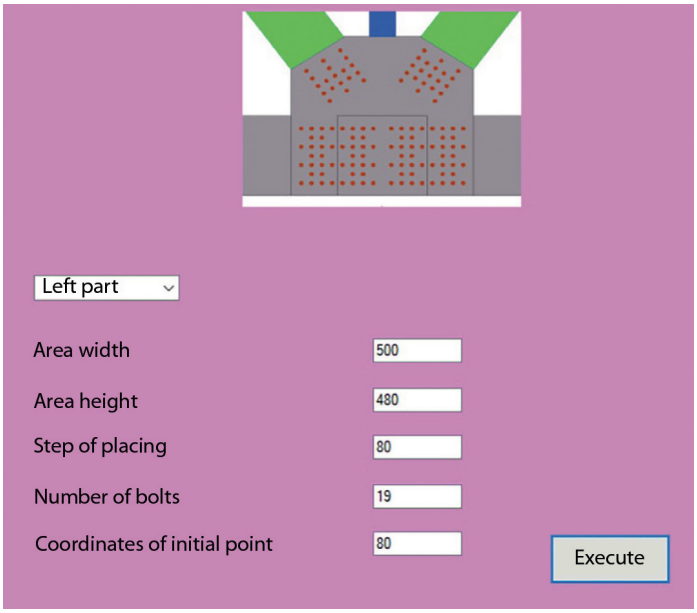
Results. *Tekla, which has an and which uses C # [2], is very convenient for automation. Let's consider*



Pic. 1. Scheme of bolt arrangement.



Pic. 2. A node of the lower belt of a through truss.



Pic. 3. Dialog box for arranging bolts.

the possibilities of creating automation tools using the example of placing bolts in the nodes of the main trusses of the metal bridge.

The standard functionality of the program offers several options for placing groups of such fasteners when selecting the tab «Bolts» [3]. But in all cases, the designer must calculate in advance not only the number of bolts, but also their location. Drawing up a working chart takes a certain amount of time, since all the requirements for the bolt pitch must be taken into account.

Requirements for arrangement of bolts in the nodes of the main trusses [4]:

1. The number of longitudinal rows of bolts must be odd.

2. In the first, second and last cross rows, the maximum number of bolts (in the compressed only 1st and last row) is set in 160 mm increments.

3. The extreme longitudinal rows are set in increments of 80 mm.

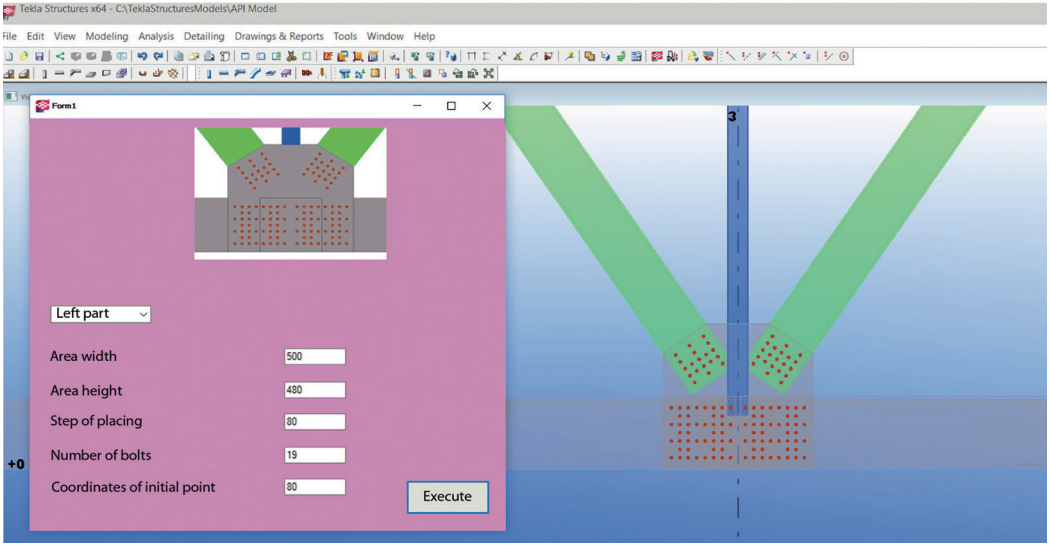
4. The bolts are placed symmetrically relative to the longitudinal axis of the element.

5. Bolt field must be compact.

The minimum pitch for bolting is usually taken to be 80 mm.

An example of a placement of bolts in a node fastening the braces in the node in Pic. 1 is made taking into account all requirements.

Using the standard Tekla functionality, you can set the group and execute the necessary procedure for



Pic. 4. The result of the plug-in for arrangement of bolts.

drawing such a scheme in two passes through the «Bolts» tab.

To reduce the time required for the operation, an algorithm is proposed in [5], which allows one-pass arrangement of bolts taking into account all requirements. The location of each bolt is calculated automatically, not manually.

Initial data for the algorithm:

- *width and height of the area for placement of bolts;*
- *number of bolts;*
- *step of arrangement;*
- *coordinates of the point at which the calculation begins.*

To implement the algorithm, a program (plug-in) is created that performs the arrangement of bolts. This demonstrates an open approach to BIM, which makes plug-in writing a convenient way to customize the interface and the necessary functionality for programmers.

As an example, the fastening of the braces to the lower belt of the through main truss was chosen (Pic. 2). The crosses mark the points from which calculation begins for each area.

Using the interface, a dialog box has been created for arranging the bolts. In the appropriate fields, the designer specifies width, height and starting point of the area in which the bolts are placed, and the step and number of bolts are specified simultaneously (Pic. 3). Clicking the «Run» button starts the process.

The result of the program for four areas where it was necessary to arrange the bolts is shown in Pic. 4. If it is necessary to change the location of individual bolts, this can be done easily, since they are drawn separately, rather than an array.

Conclusion. *Using the proposed algorithm allows to configure a comfortable working environment and increase the efficiency of the designer when performing non-standard, but routine tasks. The algorithm can also be useful in the process of training students and Ph.D. students of construction specialties at the expense of their formalization.*

Modern technologies in the design of transport and construction objects accelerate the creative process and make it more efficient. Extending the functionality of BIM programs with plug-ins allows the designer to reduce the chance of error and free up time to find more productive solutions.

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Article received 31.10.2017, accepted 16.12.2017.