ANALYSIS OF INFORMATION MODELING PROGRAMS WHEN DESIGNING BRIDGES

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ABSTRACT

The article considers a new approach in the design of bridges (BIM-technology), which consists of creating a digital information model containing all information about the future object. When using BIM-technology, the changes made are automatically synchronized and updated for all participants in the process. The review and the comparative analysis of the software complexes realizing a design task: Revit and Tekla is executed. The Revit program has a large number of building element libraries. There are no such libraries for bridges, so special tools are needed, the creation of which requires considerable effort and time. The Tekla program offers a large library of useful elements, a functional interface for designing nodes and convenient means of generating custom extensions.

Keywords: bridge, digital model, BIM-technology, information modeling, computer-aided design system, software complexes.

Background. *In the practice of designing building structures, BIM technology is increasingly being used, which gradually takes the place of the industry standard. It involves construction of one or more precise virtual building models in a digital form. The use of models facilitates the design process at all its stages, providing more thorough analysis and control [1].*

In the process of information modeling of buildings, the team of designers creates a digital model of the design that contains a database of all elements, links between them and other information. When using BIM-technology, the changes are automatically synchronized.

Often in the design the task arises of creating documentation and a plan for the reconstruction of an existing building or bridge. When reconstructing an object, design should be carried out within the framework of existing structures, and their presence in a three-dimensional representation greatly simplifies the process and makes it more accurate.

With BIM-technology, the usual chains of interaction between designers, as well as investors and builders, change substantially. Correctly, organized BIM-model allows to translate the process of erecting construction projects to a completely different level. Designers are most responsible, since they form the basis for the entire chain of new interactions and they have at their disposal most of all the real instruments of influence.

The use of BIM-technologies in the construction of bridge structures makes it possible to identify in time the parts of the project that will cause difficulties in the erection, and draw the attention of specialists of the design organization to this. Information modeling helps builders to make all the necessary calculations taking into account visualization even before the construction of the object begins.

For contractors, the use of BIM technology allows for determination of estimated costs, 4D visualization of the construction process and the identification of collisions (mistakes), information exchange with customers, and optimizing construction, reducing waste materials, increasing productivity and saving costs.

It is obvious that BIM-technology implies the automation of information use – a new stage after CAD, which automated the creation of information.

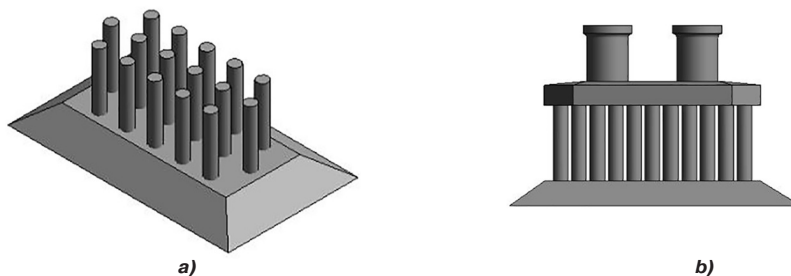**Objective.** *The objective of the author is to consider information modeling programs when designing bridges.*

Methods. *The author uses general scientific methods, comparative analysis, evaluation approach, scientific description.*

Results. *For design using BIM technology, there are several programs. Let's consider the possibilities of the Revit program, which has spread among designers of industrial and civil structures.*
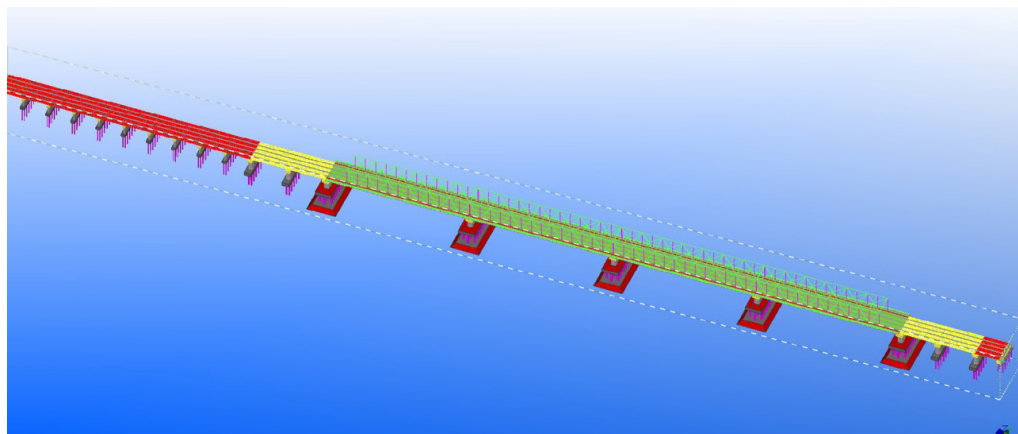
The Revit program contains a large number of building element libraries. There are no such libraries for bridges, therefore, when designing bridge elements, it is necessary to use special means. In Revit, it is possible to create own element families. A family of this kind is a generalized parametric model of construction.

Let's check the possibilities of Revit on the example of creating a family of concrete support of a metal bridge in the Republic of Myanmar.
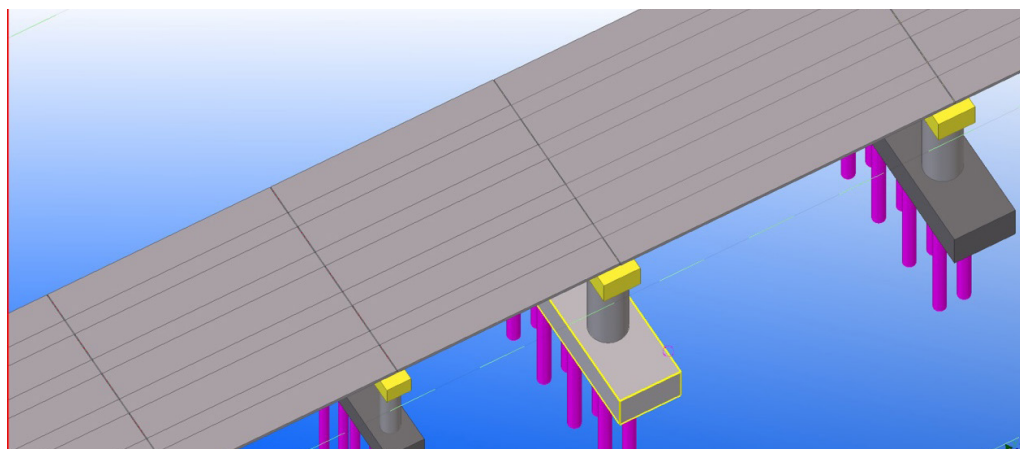
First, a fragment of the foundation plate should be formed, then a pile field is formed. The initial level for the pile field should be set below the upper level of the foundation plate, then the diameter of the circle, the location of the piles and the direction of extrusion (up) are specified. As a result, we get the form shown in Pic. 1a. The next step is joining the piles with a grill plate. It is necessary to draw contours of grillage, set the extrusion height and perform the creation of the upper part. The final stage will be the formation of the support body. To do this, it is better to use a tool that

a)   b)

Pic. 1. Concrete bridge support.

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Pic. 2. Metal bridge on concrete supports.

Pic. 3. Beams of the roadway on supports.

allows to create a shape of rotation on an arbitrary contour [2]. The result is in Pic. 1b.

Adding families to the Revit project is not an easy operation, but rather time consuming. Instead of creating a new family, it is much easier and quicker to take a ready-made family and edit it. However, the problem with the design of bridges in Revit is just that you have to build own families from scratch.

To get an information model of bridges, it is better to use the Tekla program. It also implements BIM-technologies, offering a modern interface and ease of use of its resources.

As an example of the use of the Tekla program, an information model of a metal bridge on concrete supports was created in the Republic of Myanmar (Pic. 2).

The concrete supports are imported from Revit, the beams of the roadway are placed on them (Pic. 3), then the reinforcement [3] of the supports and the carriageway is made (Pic. 4).

In the Tekla program, through bridged metal trusses of the bridge have been designed (Pic. 5), and the creation of these elements is quite simple, due to a convenient interface and a large number of different sections of metal beams.

When working with typical projects, it is possible to use standard means for nodal connections [4] in metal trusses. In the case of non-typical solutions, they are tools for extending the functionality of the program [5]. To take advantage of these features, it

is necessary to be familiar with the basics of C# programming.

Comparing the process of creating the bridge information model in Revit and Tekla programs, we can conclude that Tekla is much more efficient for designing.
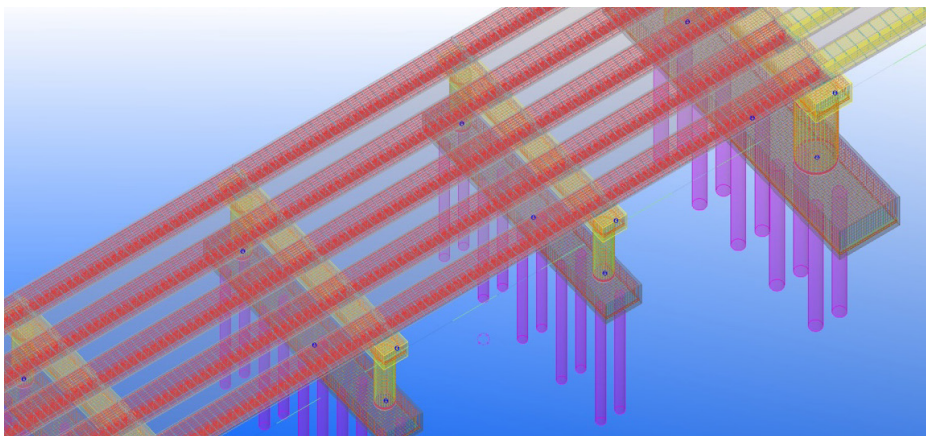
Both programs allow sharing data in different software platforms: development, adjustments, and also sending them back to the information model of the facility, including when creating a construction plan and coordinating installation work. With the help of programs it is possible to analyze variants of rasts and to demonstrate the results of development to customers. It is possible to quickly perform the calculation of structures and count the number of materials for decision making.

However, in Revit it is inconvenient to define the bridge elements, because the program architecture is oriented to formation of vertically oriented constructions, and bridge structures are constructions with differently directed geometry, and work with it is difficult. In addition, when a model is transferred to a calculation complex, its elements and nodes are not always represented correctly.
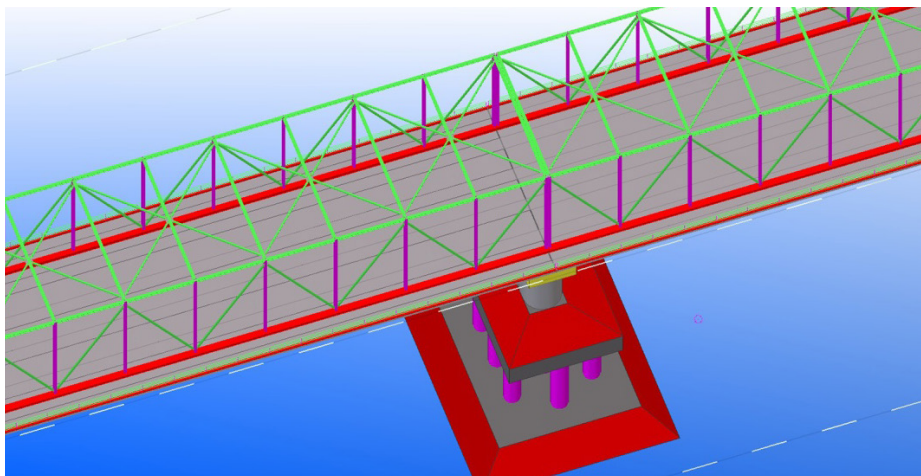
The Tekla program allows to work through the designed design in detail and very well cope with large models, providing speed and accuracy.

The Tekla software works with all kinds of materials, so the model can include prefabricated and monolithic concrete, metal, wood and any other

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Pic. 4. Reinforcement of supports and beams of the bridge.

Pic. 5. Metal trusses.

options. Using an extensive library of design nodes, users can also model, store and transfer their own components, for example, non-standard connections. The transfer of the model to the calculation complex is possible in several formats, for the nodes and connections the procedure is correct.

Conclusion. *In short, Tekla is preferable when creating a digital information model of bridges, since the program has not only a large library of useful elements, but also a functional interface for designing nodes, convenient means of forming custom extensions.*

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