

## **ARCHITECTURE AND CIVIL ENGINEERING**

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### **APPLICATION OF A 3D-PRINTER IN UP-TO-DATE ROAD CONSTRUCTION**

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*Possibility of using a 3D printer in road construction and the change from a 3D model to the finished product have been examined.*

Modern roads are a complex spatial system, the distribution of forces in which happens in a very complex sense. To express these laws in the form of analytical dependences and bring the past to the numerical results, necessary for engineering practice, are not always possible. As the experience of national and international research indicates, the nature and value of the distribution of stresses and forces acting in complex structures can be determined by examining the work-load model, created on a 3D printer.

3D graphics or three-dimensional graphics is a section of computer graphics, a set of techniques and tools that allow you to create three-dimensional objects using shapes and colors. It differs from the two-dimensional images in the way that it implies the construction of a three-dimensional model of a geometrical projection of the scene (virtual space) in the plane, and it is done with the help of specialized software. The resulting model can meet the real-world objects (e.g. a building, a person, a car, an asteroid), or be completely abstract (four-dimensional projection of the fractal).

There are many software packages that allow you to create three-dimensional graphics, that is to model objects of virtual reality and create models based on these images. Among the key leaders of such programs are such commercial products as:

AutoCAD – truly irreplaceable software for architects and design engineers. It is a powerful, functional and, at the same time, easy to operate instrument with the help of which it is possible to implement various design projects. The latest version of the utility has the tools for three-dimensional design and makes it possible to view the model from different angles, to export them with the purpose to create animations, to check the interference, to extract data for technical analysis.

CINEMA 4D is a universal comprehensive program for creating and editing three-dimensional effects and objects. It allows you to simulate objects on Guro. Support of high-quality rendering and animation.

Blender - is a development environment of 3D-models, the program is open source, freely available and supported by Blender Foundation. Being free of charge and having ample opportunities this program is becoming more and more popular in the circles of developers of three-dimensional applications.

The following programs can be added to the above-mentioned list. They are: Portable Demicron WireFusion Enterprise, VectorEngineer 2, Wings 3D, and SolidWorks.

Special attention is given to software Autodesk 3ds MAX. This is a popular software package for editing 3D graphics and its visualization. The program is perfect for creating simple and complex structured three-dimensional objects such as animals, people, buildings. The program also allows you to perform a deep simulation of the natural environment, including lighting, water, trees, wind. 3ds MAX – a true leader among the tools that are used in interior design and architecture.

As previously noted, the program 3ds MAX is the leader among similar programs, that is why we have created a 3D-model of fiberglass reinforcement namely in it (fig. 1).

Along with the fiberglass reinforcement model, the model of anchor connection has been created (fig. 2).

3D-printer - a device that uses the method of creating a physical object on the basis of a virtual 3D-model. 3D-printing may be carried out in different ways and using different materials, but the principle of a layered (growing) creation of a solid object lies at the heart of it. This printing method makes it possible to use a 3D-printer in road construction. Besides the creation of a patented glass-fiber reinforcement for its use in road building is highly probable. After the creating the reinforcing cage (figures 3), its styling should be done without human intervention, using the paddle set with a 3D-printer.

Even today, 3D-modeling is firmly established in many areas of our lives, including in the construction. Science does not stand still, and in the near future there will be much more compact printers, the materials used will become better, capability list will be expanded. The cost of 3D-press will be reduced and it will become accessible to many. Today, 3D printers are in demand mainly for small objects for preproduction, but it will take just a little time, and the emergence of small of 3D-printers for building roads, which will completely replace manual labor and reduce financial costs will become possible.

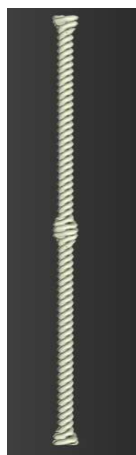


Fig. 1. Model fiberglass reinforcement

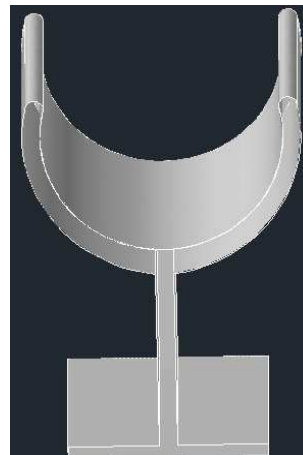


Fig. 2. Model anchoring compound

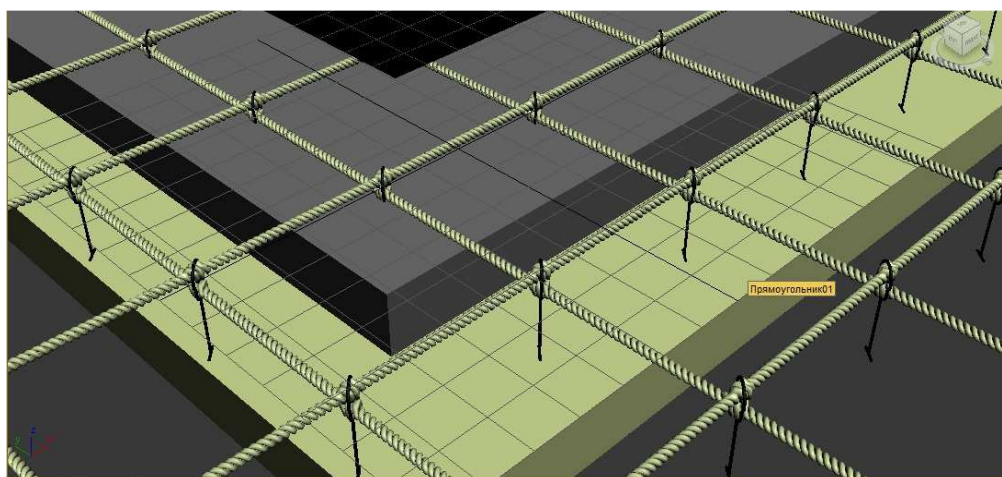


Fig. 3. Model reinforcing cage

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### ON THE EFFECT OF LONGITUDINAL DEFORMATION ON THE PARAMETERS OF THE STRESS-STRAIN STATE OF THE HINGELESS ARCH

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*The article studies the effect of longitudinal strains for two circuits of hingeless arch loading on parameters of its stress-strain state (SSS), depending on the two parameters of the arch design scheme, that characterize the degree of flatness of arch axis outlines and the extent of arch body massiveness. A significant dependence of the parameters of the stress-strain state (SSS) on the arch design scheme is established. Obtaining the numerical values of the analyzed variables is carried out in the MathCAD program.*