

USAGE OF PARAMETRIC COMPUTER SIMULATION AT DEVELOPING TASKS OF DESCRIPTIVE GEOMETRY

A. Arkhipov

Summary. Solid parametric models are offered in the Autodesk Inventor software package, which allows making automatic preparation of training materials on descriptive geometry.

Keywords: 3D-modeling, parameterization, descriptive geometry, positional problem, intersection surfaces design.

Formulation of the problem. The solution of classical problems of descriptive geometry are not severely complexity. However, simultaneous visualizations her first aids and education large number of options for the location of various geometric objects between themselves and the plane projections of rapid development and great number of various options for individual homework, ESCWA an examination notes and tests, checking their accuracy and performance of students in the automatic mode is rather complicated and interesting task, which is to B more not considered.

Analysis of recent research. For these above, was county office by the task of developing a sufficiently versatile three-dimensional computer models that meet many people at once classical problems of descriptive geometry such sections as "complex drawings," "point, line and area on complex drawings", "Positional problem" "The intersection surfaces", "axonometric projection", and get built using relevant models of visual images and drawings to illustrate lectures and preparation of teaching materials.

The wording of Article purposes. The purpose of the article is ykorystannya verdotiln t s Parametric Model for machine and hey ted wi th the preparation of training materials and descriptive geometry.

The main part. Solving positional simplest tasks of descriptive geometry does not include ownership of the unit three-dimensional solid-state modeling. However, the use of this device can be quite appropriate. Thus, when computer models bath point can be replaced by small diameter sphere, a straight line - a cylinder (still smaller diameter), and the plane defined by the triangle can be obtained as part of squeezing a small amount. So simple geometric objects (point, line, plane) can be replaced with solid state counterparts, of which, using modern design packages can be easily obtained corresponding complex drawings.

Fig. 1 shows the results of construction in the environment Autodesk Inventor point A (20, 10 30). Sketches that define

point A in space, served as a path for extruding a circle of small radius. They are "wired" display will replace the lines on drawings. In the vicinity of point A mounted orthogonally oriented cube, on the faces of which bear the designation point corresponding to the horizontal, frontal and profile projection point. This will identify the point on the drawings.

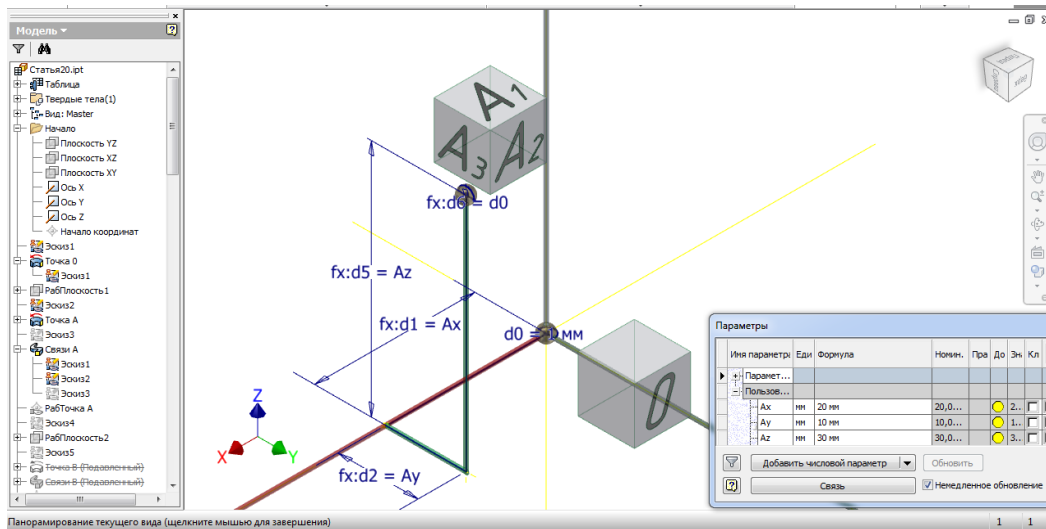


Fig. 1. Construction of three-dimensional model point.

Similarly, point A (in the environment of the establishment detail) built another 5 points - B, C, D, E, F. Their coordinates are entered in the parameter table Autodesk Inventor user and can be easily changed. After you needed stimulus at work planes and sketches using extrusion operation, we obtain the parametric model triangle ABC (Fig. 2 a) and DEF, straight DE, pyramid AVSD. Centers cubes with symbols outlets tied to extended medians of triangles. It will enjoy a spread triangles denote peaks on all projections of complex drawings that we continue to create.

Modern versions of these packages as Autodesk Inventor [1], Solid Works, Compass, T-Flex CAD provide ample opportunities to create parametric models bodies of different geometric shapes. However, it is the latest version of Autodesk Inventor [2] give a significant advantage when you need under one parametric model to take into account the most essential changes of geometry of the body. Function Inventor iLogic, which appeared to them to prescribe allows the stage model creation certain instructions that directly affect the geometry model.

Use iLogic allows you to disable the browser (wood constructions) Autodesk Inventor those elements in our case - triangle DEF, DE straight or pyramid AVSD, the construction of which for a given geometric problem is required. Parameter «Task», which introduced us to the table settings, user is responsible for the serial number of positional

problem. Thus, when the Task = 3 disabled in your browser building pyramids and straight DE AVSD, that solved the problem of constructing the intersection of two triangles - ABC and DEF (Fig. 2,b).

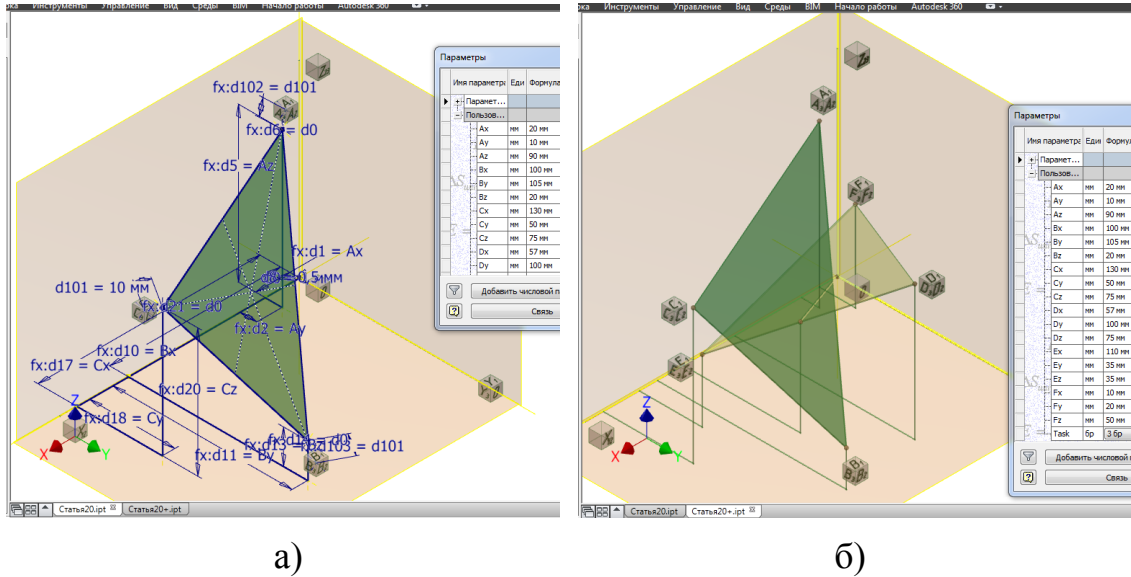
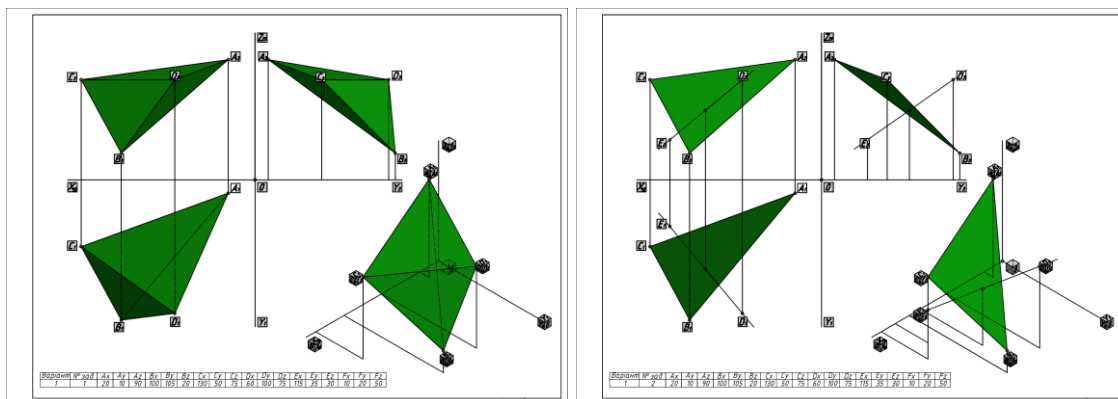


Fig. 2. Simulations triangle (a) and intercept planes (b).

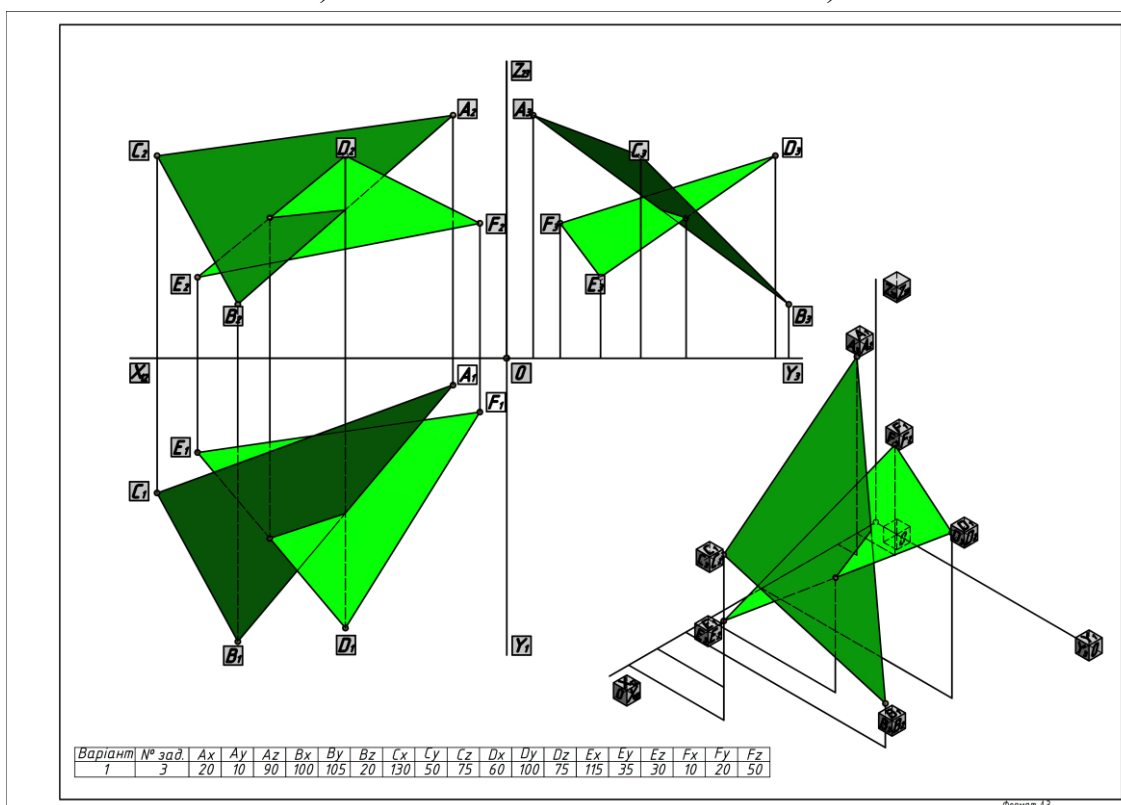
Create associative associated with this model in drawing package Autodesk Inventor takes a few minutes. This is drawings will be automatically updated when you change the coordinates of points or ordinal numbers of problem that is solved. If Task = 1, solve the problem of building the pyramids AVSD visibility and definition of edges (Fig. 3 and). Task = 2 corresponds to solving the problem of finding the point of intersection of the triangle ABC and the line DE (Fig. 3 b), and Task = 3 - solving, spatial model which submitted in Fig. 2 (b) the problem of constructing the intersection of two planes (Fig. 3,c).

Every successful version of the relative position of points A, B, C, D, E, F can be stored directly in the file details (as an option along with details of parametric performance) or row of the table in Excel, that associated with the file details. Thus, based on the created model can form many correct (in terms of image clarity at the location specified format to drawings, the necessary crossing points and lines, lack degenerate cases) options task for students. Validation of tasks, using a computer, be reduced to the choice of the serial number and the number of job option.



a)

б)



B)

Fig. 3. Complex models built drawings.

One of the main objectives of the course in descriptive geometry in high school, along with the development of spatial thinking in students, is training in construction projections simplest solids canonical form, and the lines of intersection on complex drawings. In order to fast training a sufficient number of relevant tasks was developed following parametric model.

Consider possible approach to creating a package Autodesk Inventor parametric solid models that would meet the arbitrary canonical body, which can contain from one to five holes penetrating various canonical form (deaf or cross-cutting) from those considered in the course of descriptive geometry.

Consider getting a basic element models when it looks like a pyramid, prism, cone, cylinder (torso formed oblique planes or odnoporozhnyynnoho hyperboloid). This item is based on a cross section through the task we have two sections that lie in parallel planes located at a distance model height, and two straight guides (Fig. 4).

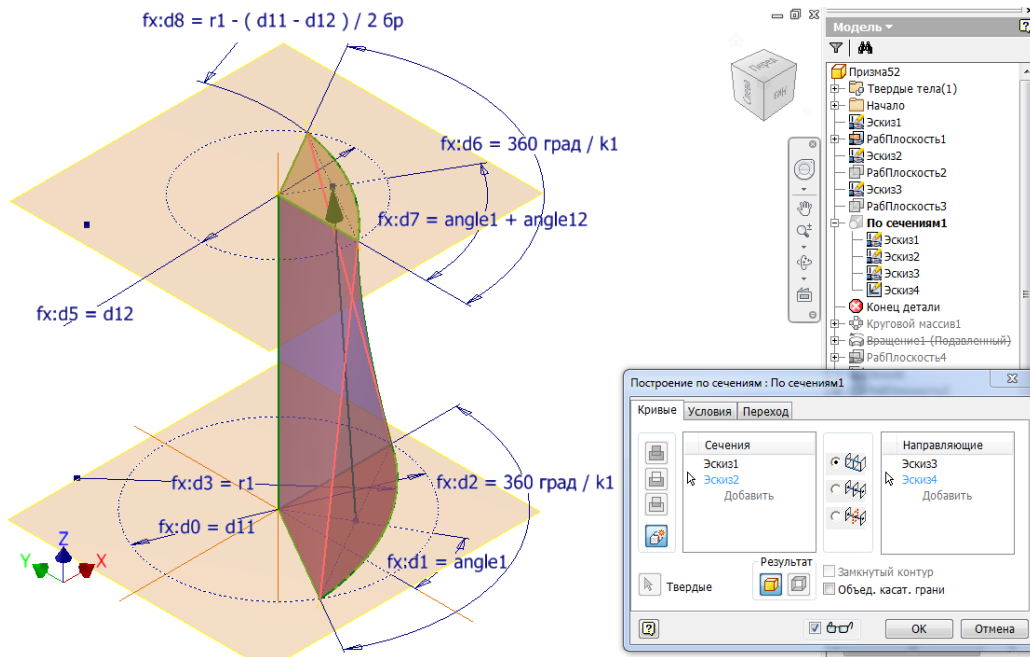


Fig. 4. Creating a basic element of the model.

Each of the sections has the form of a circle sector, which is limited angle of $3600^\circ / k1$. $k1 = 2$ - corresponds circle ($r1 = d11 / 2$). The whole value $k1$, with $k1 > 2$, determines the number of sides of a regular polygon, the underlying basic element model. Thus, the use iLogic allows you to jump from section to a segment of the circle to triangle (if $k1 > 2$).

Further ripping circular array (relative screw locally axis equal to the number of elements $k1$) obtained in sections element provides a truncated cone or pyramid with any number of sides, and the change in the rotation angle of intersection of the vertical axis ($angle1$) allows different target face surface received on the initial frontal plane.

Changing the diameter of the upper circle sector $d12$ (Fig. 4) allow, if $d12 = d11$, receive a basic element of the model as a cylinder or a prism, and tends to zero $d12$ - get a cone or pyramid. Change $angle12$ option enables the basic elements of the models are limited laterally oblique planes, and look like odnoporozhnyynnoho hyperboloid. With features iLogic basic element model can be obtained as part of the rotation when to receive the sphere (ellipsoid of revolution).

Similarly, the basic elements were created elements to form, if necessary, the horizontal and then vertical these holes. Their geometry can be just as varied.

All the parameters that affect the geometry of the model were made to the spreadsheet user preferences Autodesk Inventor (Fig. 5). Their variation provides a virtually unlimited number of forms (Fig. 6).

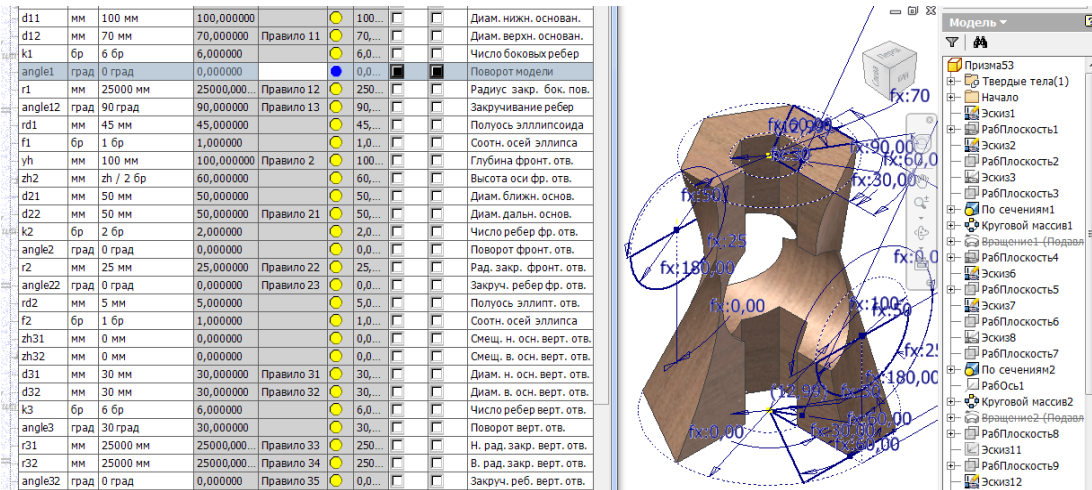


Fig. 5. The model on the desktop Autodesk Inventor.

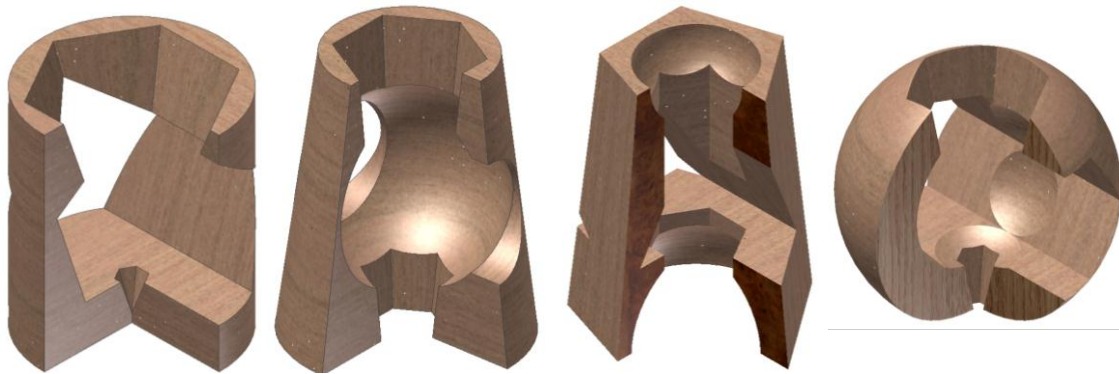


Fig. 6. Three geometry model with holes.

Based on parametric model constructed was made associate working drawings containing three projection section and isometric image of a cut of a quarter of the model. Changing user settings in Table Autodesk Inventor allows you to perform the appropriate changes in the geometry model and leads to a renewal of the working drawings.

Conclusions. Thus, the parametric computer model tion can be effectively used not only to solve engineering problems, but also have other applications, including the preparation of training materials for the course in descriptive geometry.

Built parametric models allow you to:

-form a complex associative drawings that correspond give the most common tasks positional descriptive geometry and geometric infinite number of educational models;

-clearly visualize the relative position of geometric objects and to optimize their dimensions or geometric coordinates in terms of visibility and placement on drawings specified format;

-quickly generate a large number of correct choices and conditions of home tests, examination tickets and re believe in the correctness of their performance;

-clearly illustrate methodological developments and lectures on descriptive geometry (using multimedia tools).

Some algorithms for three-dimensional models can be used in practical design activity and design.

Literature

1. Бунаков П.Ю. Технологии цифровых прототипов: Autodesk Inventor 2010 / П.Ю. Бунаков, А.В. Стариков. – М.: ДМК Пресс, 2010. – 944 с.
2. Тремблей Т. Autodesk® Inventor® 2013 и Inventor LT™ 2013. Основы. Официальный учебный курс [пер. с англ. Л. Талхина] / Т. Тремблей. – М.: ДМК Пресс, 2013. – 344 с..