

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

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of URBAN ECONOMY in KHARKIV**

Methodical recommendations
for conducting practical classes and performing independent work
on the educational discipline
**« AUTOMATED DESIGN SYSTEMS IN URBAN
PLANNING »**

*(for second-year full-time
foreigner students first (bachelor's) level of higher education
specialty 191 – Architecture and town planning)*



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Methodical recommendations for conducting practical classes and performing independent work on the educational discipline “Automated design systems in urban planning” (for second-year full-time foreigner students first (bachelor’s) level of higher education specialty 191 – Architecture and town planning) / O. M. Beketov National University of Urban Economy in Kharkiv ; comp. Viktoria Hryshyna. – Kharkiv : O. M. Beketov NUUE, 2023. – 47 p.

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INTRODUCTION

The discipline “Automated design systems in urban planning” is intended for students of the first (bachelor's) level of full-time higher education in the specialty 191 – Architecture and Urban Planning. The discipline consists of 11 topics that cover methods and tools for modeling complex architectural and urban planning objects in *Graphisoft – ArchiCAD* software. An in-depth study of this software will allow to improve the level of performance of practical and diploma works in the discipline “Architectural Design” and to freely use the acquired skills in production.

The goal of discipline “Automated design systems in urban planning” is the development of practical skills and methods of software modeling of objects of the urban environment in *ArchiCAD* software.

The task of studying the discipline “Automated design systems in urban planning” are: formation of students' skills of fast and rational work in *ArchiCAD* software, mastering the methods of designing complex architectural and urban planning objects, forming a sufficient level of mastery of the program for solving non-standard tasks.

Subject of study in the discipline – designing objects of the urban environment by means of computer modeling.

Applicants must be able to: use the acquired knowledge and skills in the project activity; **have competence:** implementation of project solutions, namely drawings and 3D modeling by means of *ArchiCAD* software.

Practical classes are built on the basis of step-by-step study and practical implementation of work project tasks in *ArchiCAD* followed by the creation of an album of drawings.

An independent form of studying the discipline is a series of practical and graphic tasks on topics learned in practical classes, approbation of the acquired knowledge during the execution of a course project in the discipline “Architectural Design”.

1 CONTENT OF THE ACADEMIC DISCIPLINE BY MODULES AND TOPICS

1.1 Formulation of the topic

Discipline “Automated Design Systems in Urban Planning” consists of three content modules, which are divided into educational elements.

The subject of the course corresponds to an in-depth study of computer modeling tools for the formation of objects in the urban environment. The graphic tasks that students perform according to the course program correspond to the topics of practical classes in this discipline, specialty 191 – “Architecture and Urban Planning”. The student must know techniques, methods, and tools of architectural modeling to create high-quality and correct drawings or images of architectural design.

1.2 Program of academic discipline

Module 1

Automated Design Systems in Urban Planning

Content module 1 Means of automated design in urban planning

In the content module, the analysis and design of natural landscapes and the creation of landscape objects in *Graphisoft – ArchiCad 25 – 26* software are studied. The elements of the Master plan, analytical schemes and the main methods of their implementation are studied. The method of designing large urban complexes is studied using the example of a parking lot: a detailed analysis of the design area is carried out; a relief of the area and a graphic sketch of the structural parking system are created.

Content module 2 Application of automated design in urban planning.

In this content module, the peculiarities of working with morphs, as the main form-forming elements when sketching and searching for a building idea, are studied. The possibilities of working with shells as a constructive and visually effective element in design are being explored. The knowledge of modeling columns and beams as structural and design elements is expanded, the “opening” tool for designing engineering networks in the building structure is studied.

Content module 3 Means of modeling the urban environment in urban planning

This content module expands knowledge of drawing design using “Graphic Overrides”, “Model View”. Work on the parking and cafe project is being completed based on all the knowledge gained, the possibilities of working with catalogs and obtaining data from the model, the “Zone” tool are being studied.

2 EDUCATIONAL PROCESS STRUCTURE

The structure of the educational process consists of three studying modules, each of which is divided into topics that consistently expand students' knowledge of work in the program *ArchiCad*. The topics are developed based on the structure of the discipline “Architectural Design”, where students immediately use the acquired knowledge in practice. This forms the integrity and continuity of the educational process. Detailed information about the structure of the discipline “Automated Design Systems in Urban Planning” is given in table 2.1.

Table 2.1 – Topics of practical classes

Topic	Contents (plan)	Number of aud. hours**
Module 1		
Systems of automated design in urban planning		
Content module 1		
Means of automated design in urban planning		
Topic 1.1 The method of creating a landscape object on flat terrain	<ol style="list-style-type: none"> 1. Implementation method. 2. Scaling of topographic maps, pasting of sketches to the program. 3. Creating a master plan drawing using 2D primitives. 4. Creation of a 3D model of a landscape object 	2
Topic 1.2 Techniques for creating a complex landscape and infrastructure on it	<ol style="list-style-type: none"> 1. Learning the “grid” tool. 2. Algorithm of work on creating a relief based on a topogodetic map. 3. Studying the methods of designing alleys and squares on the terrain 	1
Topic 1.3 Development of a master plan drawing and analytical schemes for it	<ol style="list-style-type: none"> 1. Designing of drawings of the existing state and project solution of the design area. 2. 3D concept development. 3D document 	1
Topic 1.4 Methodology for designing large urban architectural objects (parking lots)	<ol style="list-style-type: none"> 1. Selection of the structural system of the building. 2. Model development 	1
Content module 2		
Application of automated design in urban planning		
Topic 2.1 Methodology of conceptual modeling using the “morph” tool	<ol style="list-style-type: none"> 1. Learning the “morph” tool. 2. Principles of morph construction and editing. 3. Revolved method. Editing an element by “tube” method. 4. Construction of urban projects with the help of morph. Using the texture on the morph 	3

Continuation of table 2.1

1	2	3
Topic 2.2 Principles of working with the “shell” tool	1. Extruded shells. 2. Revolved shells. 3. Ruled shells. 4. Rules for placement of skylight and openings in shells	1
Topic 2.3 Creation of multi-segment structures of beams and columns	1. New methods of editing and placing beams and columns. 2. Creation of segmented beams and columns. 3. Presenting of complex columns and beams on the plan	1
Content module 3 Means of modeling the urban environment in urban planning		
Topic 3.1 Practice of working with openings and “wall end” tool	1. Methods of the opening constructing. 2. Methods of editing openings. 3. Presenting of openings on the plan. 4. Work with “wall end” tool	1
Topic 3.2 Working with “zone” tool	1. General Information. 2. Zone’s passport. 3. Creating of zone. 4. Calculations using zones and creation of an explanation	1
Topic 3.3 Principles of working with schedules	1. Basic information about schedules. 2. Creation and editing of schedules	2
Topic 3.4 Practice of preparing basic drawings for printing	1. Working with groups of layers. 2. Model View. 3. Possibilities of “Graphic Overrides”. 4. Creating your own document template	1

Examples of works are given in Appendix A.

3 CONTROL METHODS, ASSESSMENT PROCEDURE

The control methods include checking the abilities and skills of working in the program *ArchiCad*, in particular, the creation of building elements, architectural details, drawings and 3D images, graphic control (graphic works, drawings, project sketches).

Assessment is carried out according to the cumulative system in four stages: three content modules and final control in the form of a differentiated assessment. The distribution of points is given in table 3.1.

Table 3.1 – The structure of the academic discipline and the distribution of points

Content modules	Maximum number of points			
	total	practice	labour	independ. work
MODULE (semester)	100			
Content module 1	25	10	–	15
Content module 2	25	10	–	15
Content module 3	20	10	–	10
Final control	30	–	–	–

3.1 Types of tasks, means of control and the total score

Current control methods:

- performance of practical tasks in the *ArchiCAD* environment;
- testing in a virtual educational environment on the MOODLE platform;
- presentation of using practical skills of mastering the program during the project implementation from the discipline “Architectural Design”. The final control in the form of a differential assessment is carried out practically. The ability to perform the task in the environment *ArchiCAD* in the present tense is evaluated. The criterion for the successful completion of the final assessment in the form of a credit by a student of higher education is his achievement of the minimum levels of grades for each planned learning outcome.

The types of tasks and the maximum number of points are given in table 3.2.

Table 3.2 – Types of tasks and the maximum number of points

Types of tasks and means of control	Distribution of points*
1	2
Content module 1	25
Practical work № 1–2	4
Independent work to the topic “The method of creating a landscape object on flat terrain”	8
Practical work № 3	2
Independent work to the topic “Techniques for creating a complex landscape and infrastructure on it”	7

Continuation of table 3.2

1	2
Practical work № 4	2
Practical work № 5	2
Content module 2	25
Practical work № 6–8	6
Independent work to the topic “Methodology of conceptual modeling using the “morph” tool Creation of a concept idea of an architectural object”	4
Independent work to the topic “Methodology of conceptual modeling using the “morph” tool: revolved method. Creating a pavilion in a classic style”	4
Independent work to the topic “Construction of urban projects with the help of morph. Using the texture on the morph”	3
Practical work № 9	2
Independent work to the topic “Principles of working with the “shell” tool”	4
Practical work № 10	2
Content module 3	20
Practical work № 11–15	10
Independent work to the meaningful module “Means of modeling the urban environment in urban planning”	10
Final control – diff. test	30
Total by module	100

Table 3.3 – Grading scale: national and ECTS

The sum of points for all types of educational activities	Evaluation on a national scale	
	for the exam, diff. offset	for credit
90–100	perfectly	counted
82–89	good	
74–81		
64–73	satisfactorily	
60–63		
35–59	unsatisfactory with the possibility of reassembly	not counted with the possibility of retaking
0–34	unsatisfactorily with mandatory repeated study of the discipline	not counted with mandatory repeated study of the discipline

3.2 Principles of evaluation of applicants

The final grade for the discipline is set in the ECTS system for evaluating learning outcomes:

Grade «A» – the student knows how to model complex architectural objects with the involvement of all studied types of tools in *ArchiCAD*, performs graphic tasks with high quality and without mistakes, knows how to select tools based on the given task, quickly finds solutions for modeling non-standard objects, creative space.

Grade «B, C» – the recipient knows how to model architectural objects of different complexity in *ArchiCAD* with the involvement of most of the studied types of tools, performs graphic tasks with small mistakes, has knowledge of working with tools, but needs more time to select the right tool when modeling complex architectural objects.

Grade «D, E» – the student mastered the theoretical material on the possibility of working in *ArchiCAD*, knows how to model simple objects, uses only the basic capabilities of working tools.

«FX» grade – the applicant does not have the majority of the material, cannot solve the modeling tasks in *ArchiCAD*.

4 METHODOLOGICAL RECOMMENDATIONS FOR CONDUCTING PRACTICAL CLASSES AND PERFORMING INDEPENDENT WORK

CONTENT MODULE 1

Means of automated design in urban planning

The method of creating a landscape object on flat terrain

The design of any object includes 2 main stages: development of the master plan of the design area and creation of a 3D image.

A master plan is a planar representation of the structure of the object in scale, which shows the exact placement and dimensions of all elements. To work on the master plan, vector graphics – 2D primitives: lines and hatching are always used. Working on a 3D-image, we use structural elements: slabs, beams, walls, a 3D mesh, and others. In order to optimize the execution time of a landscape object, it is necessary to adhere to a certain algorithm and work methodology.

Methods of working with a landscape object

1. Development of a sketch of the projected area with main avenues, placement of buildings, functional areas.
2. Placement and scaling of the topographic map and sketch in *ArchiCad*.
3. Application of alley contours. Using lines, we draw the directions of the alleys (1 side), then by duplicating or moving, we transfer the copies to the distance of the width of the alley. At this stage, you should not pay attention to the correct length of lines and angles.
4. Refinement of alleys. It is necessary to cut off unnecessary parts with trimming, round (fillet) the corners of the alleys if necessary. After that, you need to create a new layer and transfer the lines to it so that you can turn it off whenever it will be important.
5. Adding fills. An important property of the “fill” tool is the ability to calculate the area of each of the elements. This information is required for the “Balance of Territories” table. In addition, in *ArchiCad 25*, it became possible to

give the fill the appearance of a surface, which significantly improves the graphic design of the master plan. To create fill, using the “magic wand” is needed. For this click the cursor inside the closed contour while holding down the “Space” bar. Fill is also better placed on a separate layer.

6. Creating 3D model of the alleys. To create a landscape in 3D, we use the “3D grid” tool. Select a tool and assign a texture to it. With the first layer, we create one large object that will cover the entire area of the park and assign with the texture of surface of the alleys, the image on the plan – “background”.

7. For creation of 3D view of the lawns the 3D grid is used. Increase its mark by 50-100 mm (since lawns are usually higher and have a border), change the top texture to “grass”, the side texture to “white” or “concrete”, assign the image on the plan to 50 % green transparent color, the contour pen on the plan is black. We build a lawn by using a “magic wand”.

8. Creating borders. For borders, we set the required size of the wall or beam and click on the contour of the lawn, pinching the “Space” bar. Repeat for all lawns.

Thus, we can see that the main part of the time when executing the project of a landscape object on a flat area falls on the sketching and detailing of the master plan – 2D drawing. An example of implementation is given in figure 4.1.

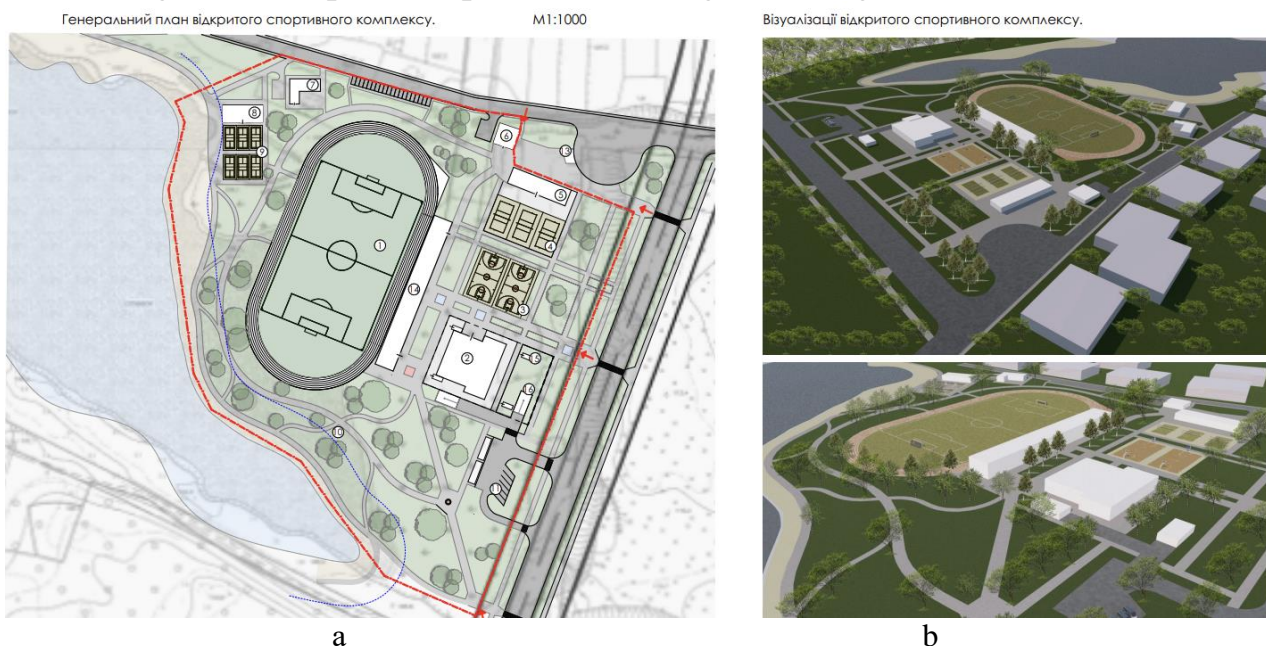


Figure 4.1 – Master plan (a) and visualization of the project (b)

Scaling of topographic maps, transfer of sketches to the program

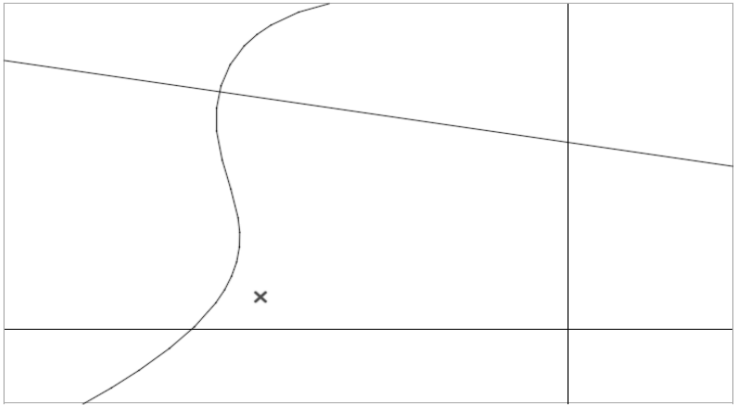
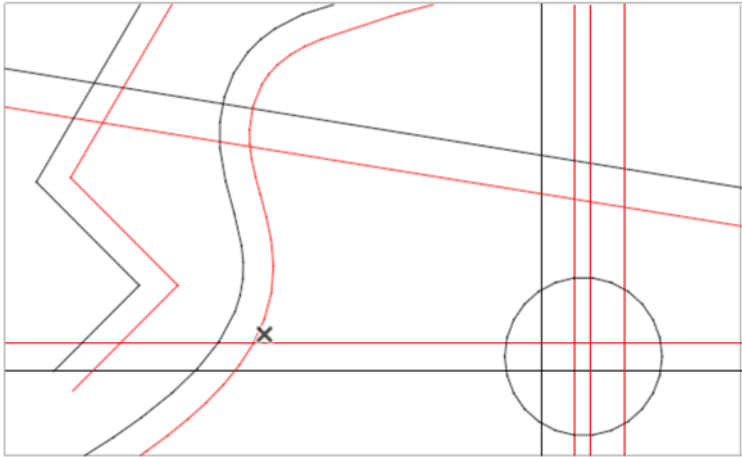
Working with topographic maps and sketches, it is necessary to scale them correctly in the program. At the beginning of work, you need to set same scale as the map was created in *ArchiCad*, and then past and place the map in the workspace using the “drawing” or “image” tool. After pasting the map, it is necessary to check the distance between the crosses, if there are none, you can choose a building and check its size and compare it with the size in *GoogleEarth* online map. After making sure that the map is the correct scale, you can change the scale of the program to the one you

need for work. It is necessary to pay attention once again that *ArchiCad* always creates an object in real size, and the scale is required to output the project to print.

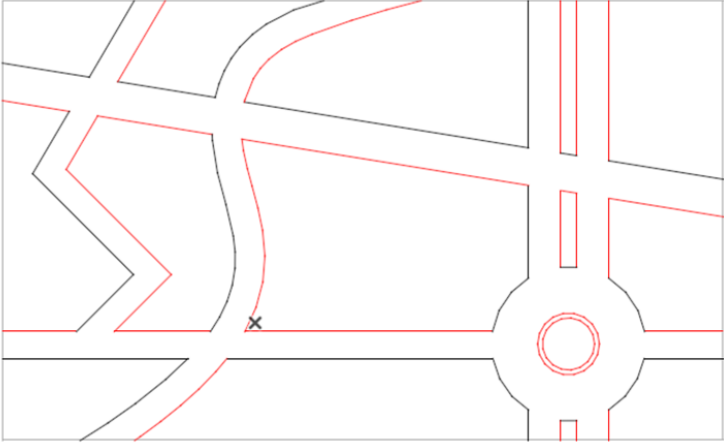
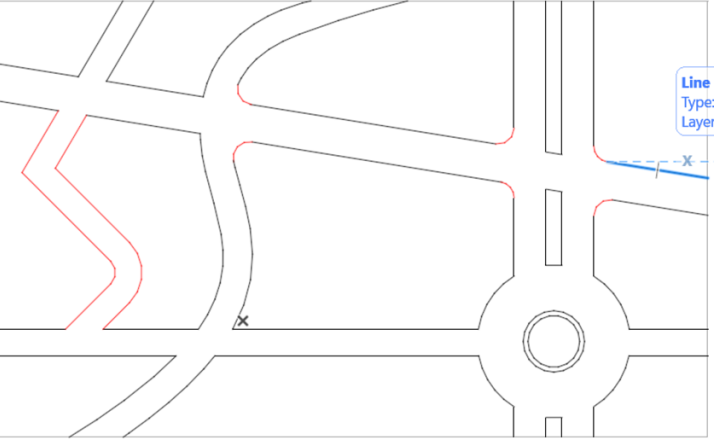
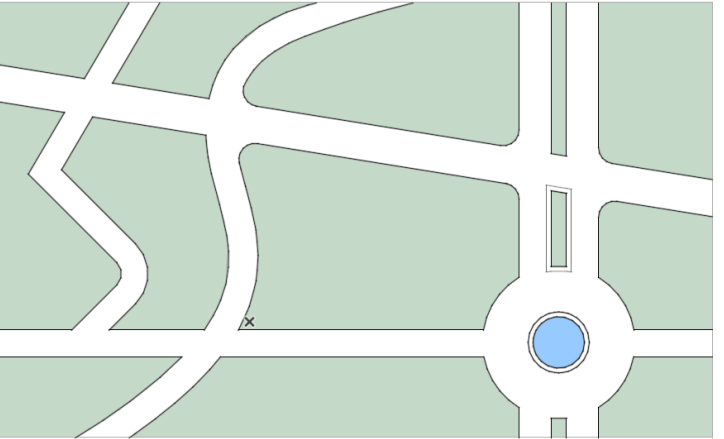
Since the sketch is mostly converted into a photo for using in the program, it does not have an exact scale, even if it was made on a topographic map. To scale it, you need to use the following steps: «*Edit*» – «*Reshape*» – «*Resize*», which is much more accurate than «*Stretch*» as use dimensions. In order to accurately scale the sketch and fit it to the topographical map, you should choose a common element on the sketch and the map, for example, a corner of an existing building, a point on a road, etc. Place the image so that this point on the sketch and the map coincide, activate the «*Resize*» function and define two points by which the sketch will be scaled. The first point is always the one that was in the previous step, the second point can be the second corner of the building, etc., the distance between which is known. Scaling is checked against on the other points or objects.

Creating a master plan drawing using 2D primitives

Table 4.1 – Algorithm for drawing the master plan of the landscape object

Steps of performance of work	
	<p>Step 1 Determining the directions of alleys</p>
	<p>Step 2 Duplication of alley contours</p>

Continuation of table 4.1

	<p>Step 3 Trimming off unnecessary elements</p>
	<p>Step 4 Rounding (fillet) the corners of lawns and flower beds</p>
	<p>Step 5 Add Fills</p>

The technique for creating winding alleys

1. We create one side of the alley using a spline (for winding alleys) or a polyline (for polygonal ones).
2. Select the spline and use the function “offset all ages” + CTRL (create a duplicate), move the spline to the width of the alley. This method helps to create an alley with the same width along its entire length.

3. Next, we act as with regular structures: we create a landscape with using a 3D grid.

Creation of a 3D model of a landscape object

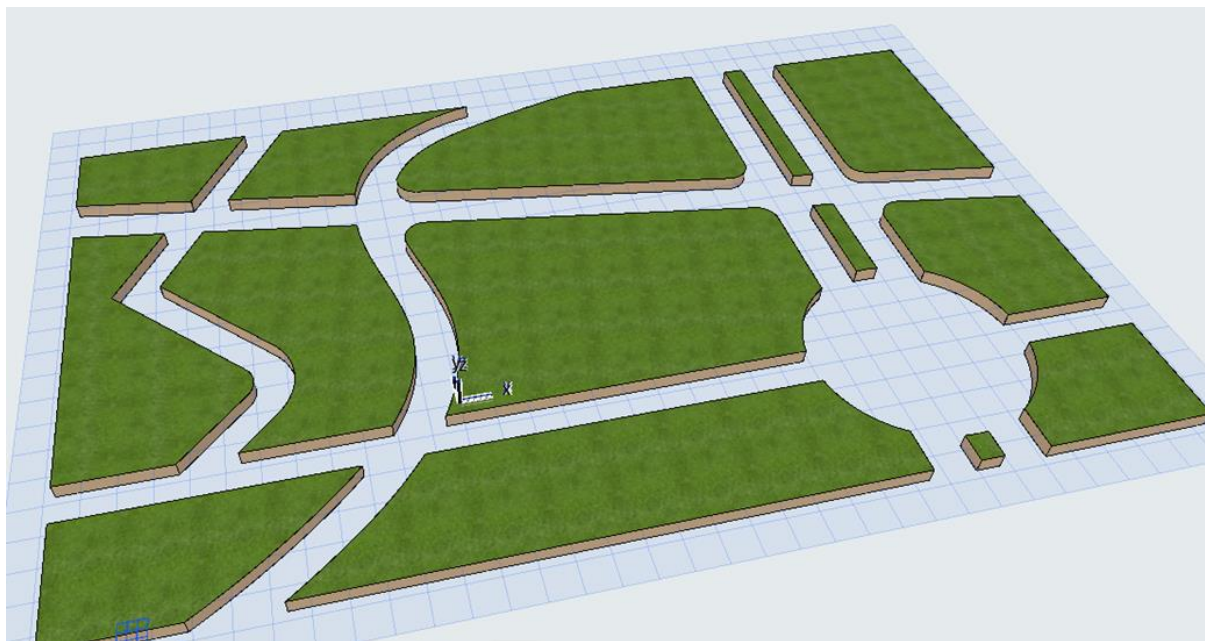


Figure 4.2 – Creating of lawns in 3D view

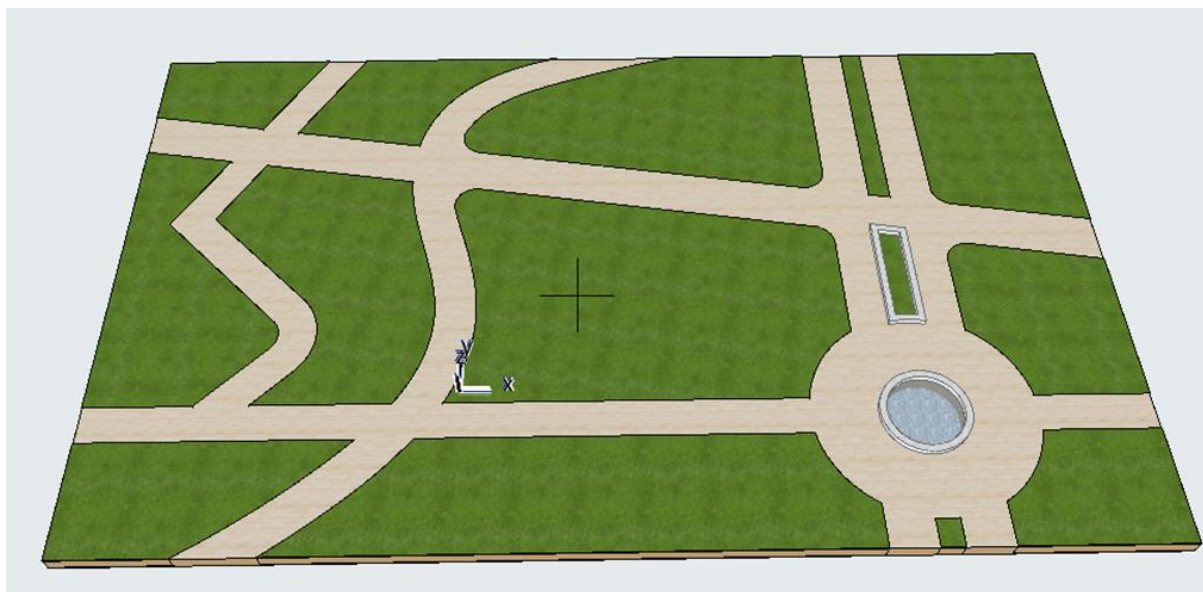


Figure 4.3 – Finished part of the park without greening

***Independent work to the topic
«The method of creating landscape objects on flat terrain»***

According to the provided drawing, develop the master plan of the landscape object with the help of 2D primitives, draw up the master plan with fills, make a 3D image of the park. Print a drawing and visualization on an A3 sheet with a stamp and a frame.

Techniques for creating a complex landscape and infrastructure on it

Learning the “Grid” tool

Grid is a 3D modeling tool that creates a shape using many different shaped faces. Each point of the face can be placed at a different height, which allows you to create complex shapes (Fig. 4.4). To form faces, it is necessary to create polygons – lines on the grid using 2D primitives.

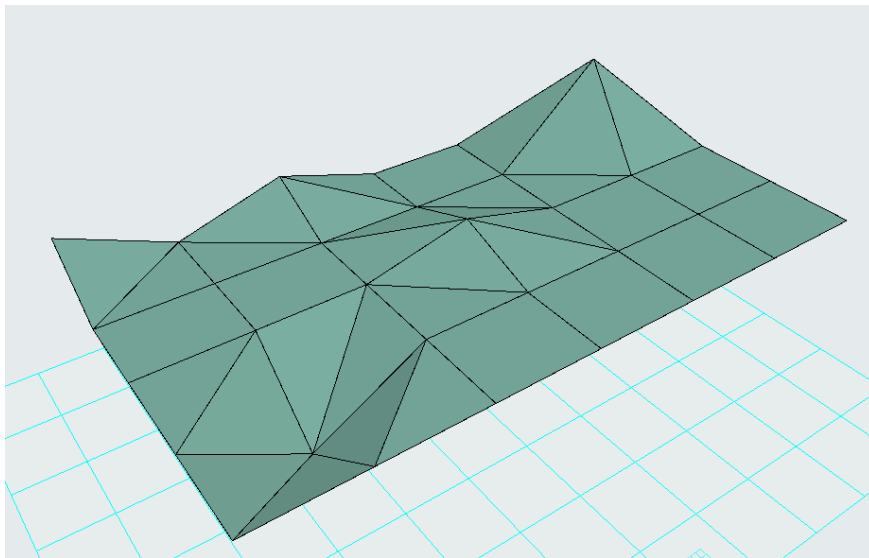


Figure 4.4 – Shaping the surface using the “Grid” tool

Algorithm of work on creating a relief based on a topogodetic map

1. *Creating the shape of the plot using 3D grid.* If the shape is simple or polygonal, you can use the building method “by points”, if it is complex with rounded borders, it is advisable to first create the shape with lines and splines, and then create a grid using the “magic wand”.

2. *Drawing all horizontals using splines.* If there are a lot of horizontal lines, you can draw every second or third horizontal line, noting that there will be a gap of 2 or 3 meters between the splines. It is advisable to immediately create a separate layer for horizontals. On the drawing of the master plan, instead of a map, you can use drawn horizontal lines, which are often performed in black, gray or white colors, depending on the graphic idea.

3. *Connecting the horizontal lines to the 3D grid.* To do this, select a 3D-grid on the plan drawing, then activate the 3D grid tool on the toolbar, then move the cursor to the horizontal and, calling the “magic wand”, attach the horizontal to the grid. A new spline will appear in place of the spline. After connecting all horizontals, it is better to turn off the layer with horizontals-splines.

4. *Building a relief.* Select the 3D grid on the plan and select the horizontal. In the pop-up editing panel, find the function “move along the Z axis” and define the horizontal height. You should move either from the lowest “0” horizontal, adding +1 (2 or 3) meters to each subsequent horizontal, or vice versa, from the highest, reducing

the next ones by -1 meter. The height change should be applied to all points on the spline at once (chosen from the pop-up menu).

5. *Editing the edges.* After the construction of the relief, there remain points along the plot contour that did not coincide with any of the horizontal lines and their height was not changed. It is better to edit these points in the 3D view by setting their height along the Z axis. In this case, you should adjust each such point separately.

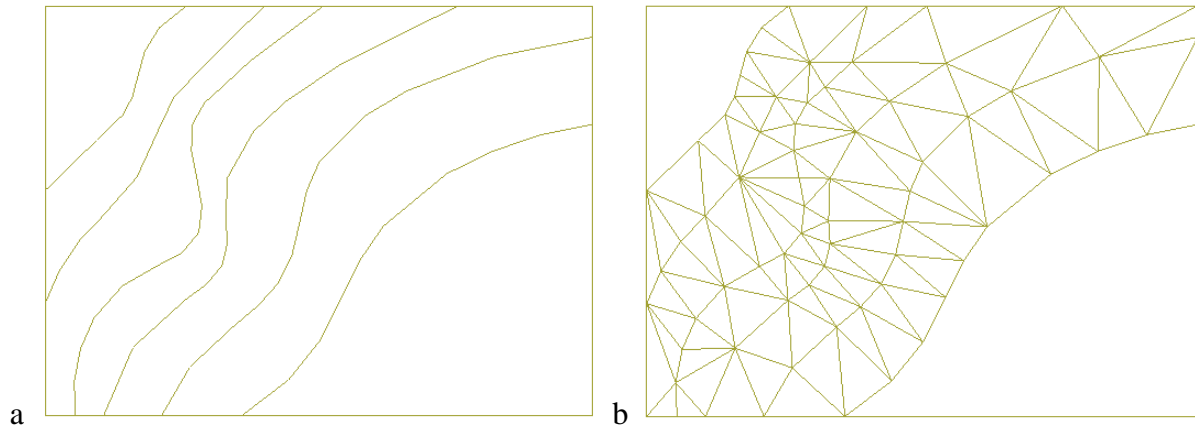


Figure 4.5 – View of the 3D grid on the plan: a – when the horizontals have not yet been set to a height; b – after setting the height

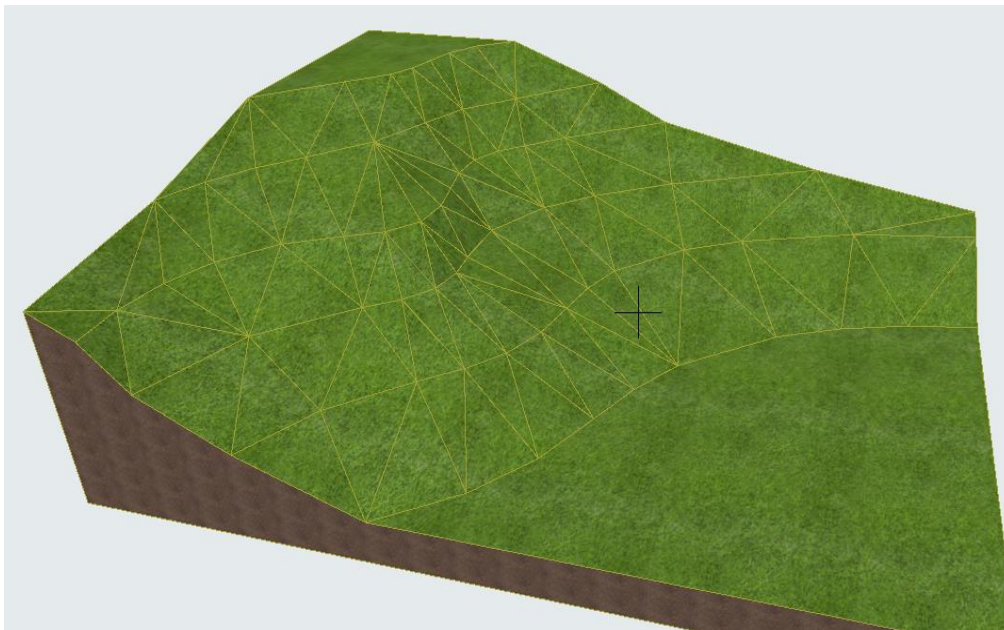


Figure 4.6 – View of the built relief

Studying the methods of designing alleys and squares on the relief

To build alleys, it is necessary to understand for what purposes 3D is created: for general display without detail or for working drawings. In the first case, the accuracy of the slopes of the alleys is not very important, but the general appearance, for example from a ‘bird's eye view”, is important. In the second case, the construction of alleys is very accurate, taking into account longitudinal and transverse slopes, stairs, etc.

Non-detailed construction method

To do this, you should draw all the alleys using 2D primitives. Next, we create a copy of the constructed grid and place it 100 mm above the first one. At the same time, the upper layer will have a “grass” surface, and the lower one will have “paving”. Next, we subtract shape of alleys from the upper layer. This is possible with using a “magic wand” or manually. If there are incorrect moments in 3D, you can edit a separate point. If the 3D grid thickness is not displayed in the 3D grid is thin and no soil is visible, you should change the grid thickness. It should be greater than the height difference of all horizontal lines.

Detailed method

The detailed method involves building a relief and subtracting all alleys from the grid. Next, alleys are created using the new 3D grid. At the same time, new edges or points should be added to the grid in places where the relief changes, in order to be able to correctly lower the points and create the necessary slope of the alley. At the same time, the terrain will sometimes be higher or lower than the alley. The project will use the vertical planning of the site, and in the model, the height adjustment of each point of relief along the contour of the alleys. If necessary, stairs will be created in some areas.

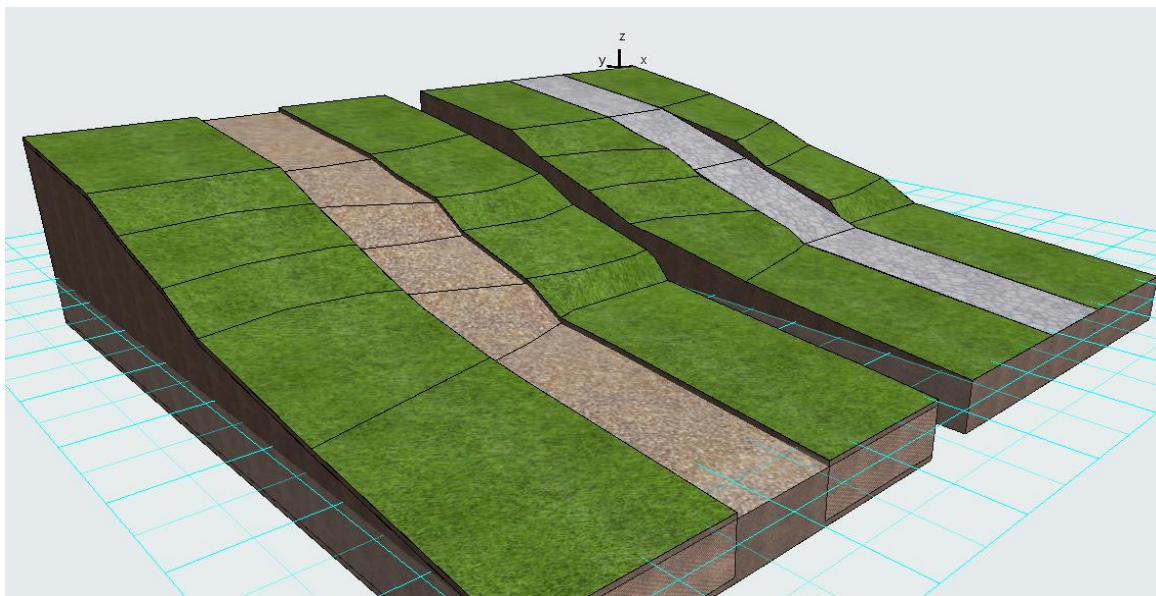


Figure 4.7 – Methods of building alleys on the terrain: on the left – non-detailed, on the right – detailed with a fixed slope of each section of the alley

Independent work on the topic

«Techniques for creating a complex landscape and infrastructure on it»

With the help of a geodesic map, create the relief of the area selected for a parking lot or cafe, build two types of alleys on it: detailed, non-detailed. If the terrain is flat on both sites, choose any other site to practice. Paste a visualization on an A3 sheet with a stamp and a frame, save in pdf format.

Development of a master plan drawing and analytical schemes for it

Designing of drawings of the existing state and project solution of the design area

Project activity is always preceded by an analysis of the territory and presentation of the conceptual idea of its planning. In addition to the site, the project is also influenced by the external environment. Urban planning restrictions and proportions of the space: street width, height and length of the building, definition of accents and dominant are very important for choosing the shape of the future object. Previously, for this, a “bird's-eye view” of the area was created in sketch graphics, now we can make a 3D model on a computer. This method is less creative, as accurate as possible. After building the environment model, we can, moving around the scene, determine the most active view shots from which the project will be viewed and fit the object into the already existing environment as much as possible, as a result of which an ensemble is created.

To create planar analytical schemes: analysis of the existing state of construction, functional, landscape-compositional analysis, etc., 2D graphics are used, which can then be easily converted into 3D. So, on the basis of the building height scheme, where each building has a 2D contour and a known height, you can quickly raise the height of buildings with the help of a slab, grid or morph. For the formation of roads and landscaping of yards, it is worth using the method of designing landscape objects on a flat and complex landscape. So, the lowest level will be the level of the roadway part of the street, for which it isn't important to draw the contour and not reload the program, but create one large object that will cover the entire modeling area and form all the roads. The second layer will be a layer of pedestrian alleys, located 150-200 cm above the roads. It will have an outline along the contour of roads and driveways. The third layer creates greenery, which will be 5-10 cm higher than the alleys. You should already draw a contour for it. However, if you first create a foundation in 2D using editing methods: duplicating, copying, then you can quickly fill them with a “magic wand”. For the design area, it is worth studying the relief in detail and modeling it, as it can affect the design decision.

3D concept development. 3D document

In addition to the idea of the form, the 3D concept of the project can reflect many internal elements. So, in addition to the finished visualization, the project includes: functional zoning scheme, insolation scheme, compositional solution scheme, lighting scheme, visitor movement scheme (for museum complexes, etc.). Usually, these schemes are created using a simplified 3D model (without detailing, surfaces, trees). To do this, it is necessary to turn off the detail layers on the model, turn it to the desired angle and create a 3D document.

A *3D document* is an image of an object or a part of an object (if it is cut off with frames) saved in a certain perspective, which can be sized and refined using lines and fills.

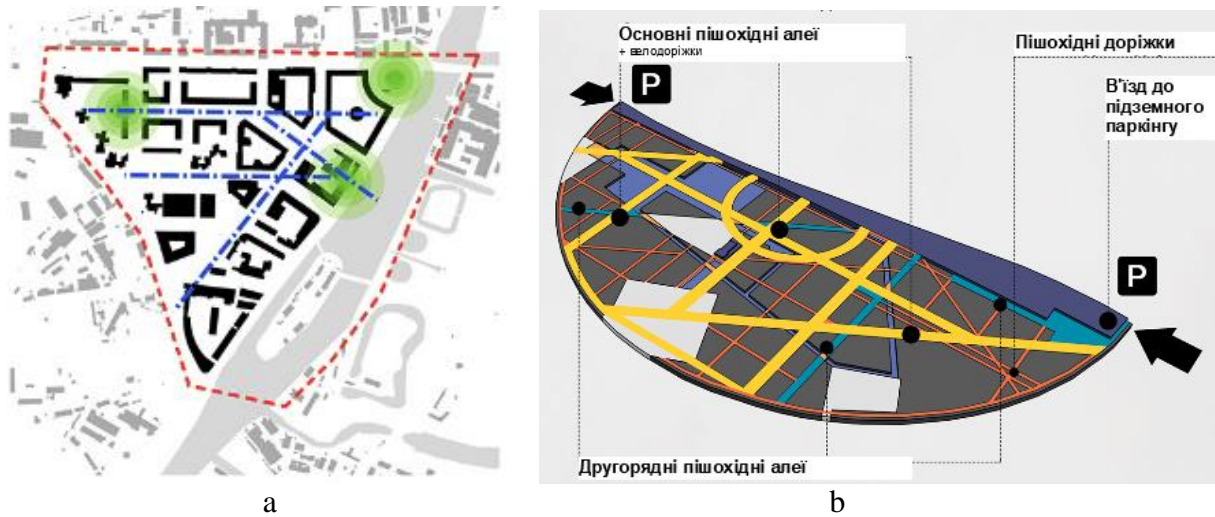


Figure 4.8 – City planning schemes: a – 2D scheme of compositional analysis;
b – 3D diagram of the structure of pedestrian alleys

Methodology for designing large urban architectural objects (parking lots)

Work on any architectural or urban planning object should begin with sketching, and only when the idea of planning, functional zoning and appearance are found on the sketch – it is logical to begin its implementation in *ArchiCad*, or any other program.

Selection of the structural system of the building

Before starting work, the main parameters of the building and its structural system should be determined (Fig. 4.9):

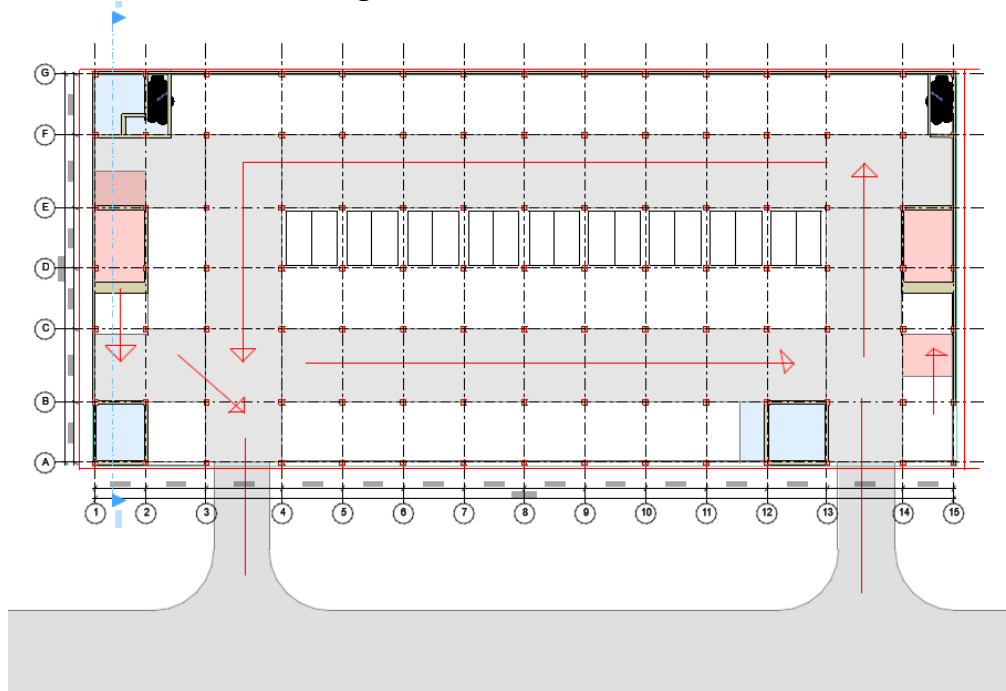


Figure 4.9 – Sketch-idea of the parking lot with the image of movement and arrangement of cars in *ArchiCad*

1. Determine the height of each floor (depending on standards and structures) and how many floors the building will have. In the program in the tab: «Design» – «Story settings» set the required number of floors and their height. If there are underground floors, they will be below the 0.000 point.

2. Determine the construction system of the parking lot (step of columns) and draw a grid of axes, immediately adjusting all its parameters in the tab: «Design» – «Grid system» (axis system). The grid of axes will depend on: the number of cars you want to place between 2 columns, the placement of passageways and ramps for communication between floors, the main entrances and exits from the parking lot (all these decisions must be found in the sketch!). If you make a sketch in an *ArchiCAD*, then first set the grid of axes without placing columns and placing cars, find the location of all elements, and then work with the columns. Cars should be placed only after approval of the structural system at the stage of preparing the plan for printing. At the stage of designing the building, it is better to highlight the passageways with fills.

Model development

1. Columns can be created along a grid of axes. It is advisable to use the replication method. We place external walls where necessary.

2. Along the grid of axes, lay out the beams that will hold the slab.

3. Create a slab (preferably from a complex structure, which will include: an element of a core structure made of concrete and a upper layer made of asphalt or bitumen).

4. Create other structural elements: ramps, evacuation stairs, elevator shafts.

5. If the overall design of the appearance is known, you can add decoration of walls, windows, fences, etc.

6. Copy all elements of the first floor to other floors. To do this, click in the navigator on the floor on which you designed with the right mouse button and select: edit elements by floor. We choose the floor from which the elements will be copied, the type of elements and the floors on which the elements will be copied.

7. Finalize the model. Using a 3D grid or a simple slab, we create land, roads leading to parking lot entrances, sidewalks, and lawns.



Figure 4.10 – Completed 3D model of the parking lot

CONTENT MODULE 2

Application of automated design in urban planning

Methodology of conceptual modeling using the “morph” tool

Learning the “morph” tool

Morph is a 3D modeling tool that allows you to create any object of any shape, from urban planning concepts for the development (reconstruction) of large areas to interior elements: sofas, chairs, etc. The morph can be designed and modified in maximum detail by working with vertices, edges and faces. The main difference between a morph and structural elements (wall, beam, etc.) is that it does not have information about the material from which it is made, but only the surface. The texture can be assigned to each individual face of the object, helping to create fairly realistic objects.

Geometry methods of building morphs are divided into the following:

- 1) planar: polygonal in points, rectangular, circle and others. They create objects with a thickness of 0, that is, completely flat;
- 2) volumetric: parallelepipeds and bodies of revolution. They can be created both in 2D and 3D view.

Principles of morph construction and editing

It is best to familiarize yourself with the possibilities of morph editing on a simple figure (parallelepiped). To do this, activate the “morph” tool, choose the “parallelepiped” building method and determine its size in the plan and the extraction height (graphically in the 3D projection). To select an editing element (face, vertex, edge), hold down the CTRL + SHIFT keys and define the element with the mouse by moving the cursor over the object (the face or edge will be highlighted), click on it, and then again to open the editing panel. So, for example, the displacement function for each of the elements will give a different result (Fig. 4.11).

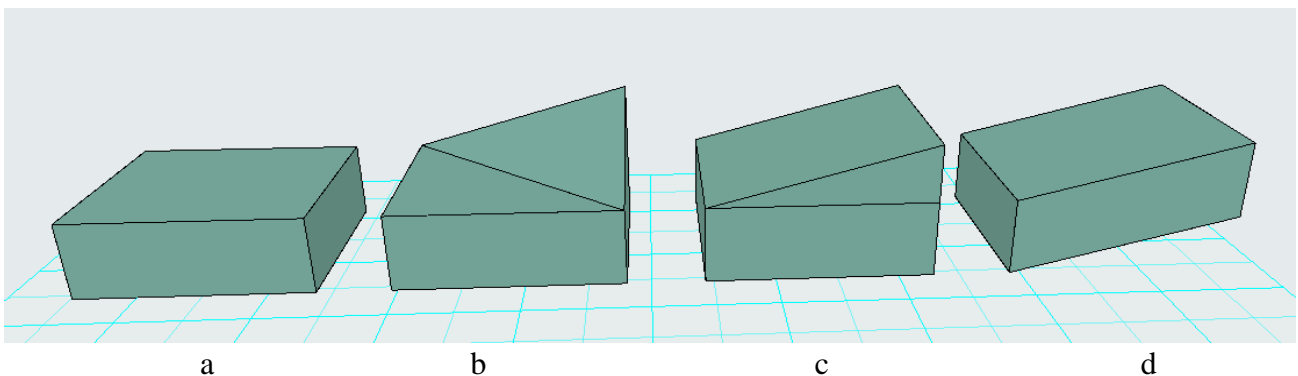


Figure 4.11 – The response of the shape using the movement function: a – the shape without changes; b – displacement of the vertex; c – edge; d – face

Vertex editing tools: move, round a corner or make a chamfer, shift all the edges of the face to which this vertex belongs, draw (add) a new morph using any planar or three-dimensional method.

Edge editing tools: move, insert a new vertex, round an edge, offset an edge, offset all edges included in this face, rounding the entire edge, draw (add) morph (Fig. 4.12).

Face editing tools: push/pull, tube along a trajectory, creating a bulge (radius and depth of extrusion are set), offsetting all edges, adding a morph by drawing (Fig. 4.13). Edges and faces can also be removed from the morph. To do this, select a face and press the “Delete” key.

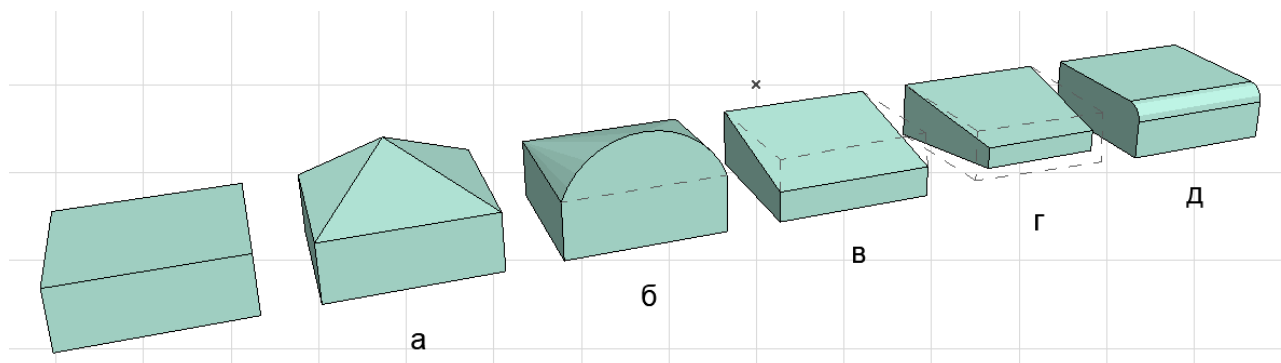


Figure 4.13 – Editing edges: а – adding a point and moving it; б – edge rounding; в – displacement; г – displacement of all edges; д – rounding (fillet/chamfer) of the edge

In order to add edges to the face, you can select the desired edge, activate the move function and hold down CTRL, and then move the new edge to the desired place, or use the duplication function. The same function can be done for several edges at the same time by selecting them by pressing CTRL + SHIFT. When selecting several elements, the shape can be rotated using the rotation function. In order to disable rotation and continue selecting elements, you need to press Escape.

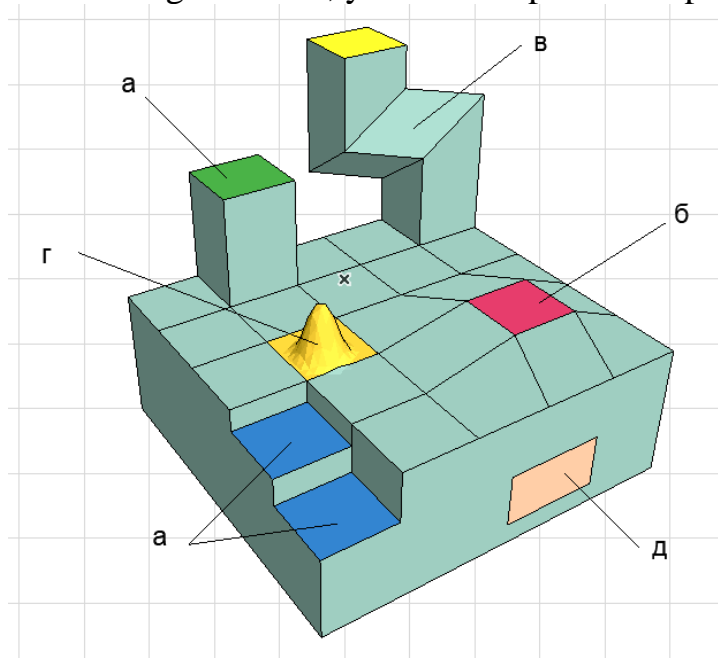


Figure 4.14 – Editing of faces: а – push/pull; б – move; в – tube along the given trajectory; г – to create a bulge, convexity; д – add a new morph

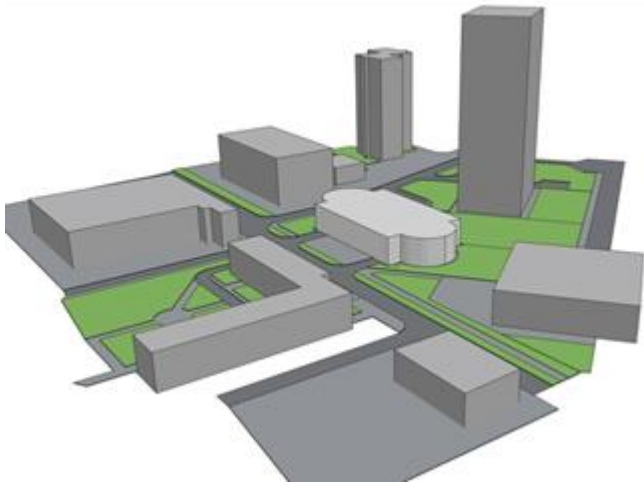


Figure 4.15 – Modeling the urban planning situation using a morph

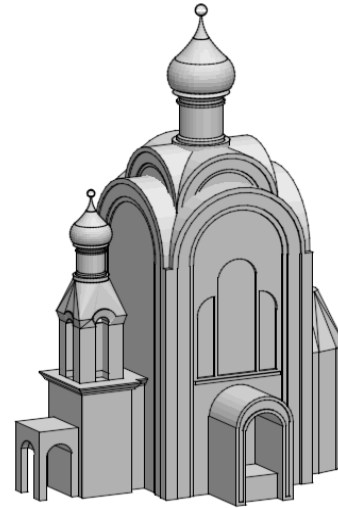


Figure 4.16 – Modeling an architectural object using a morph

***Independent work on the topic
«Methodology of conceptual modeling
using the “morph” tool. Creation of a concept-idea of an architectural object»***

Develop, by choice, a design concept of a cafe or parking lot with using of a “morph” tool, or design an urban environment around the design area. Place the 3D image on an A3 sheet with a stamp and a frame.

Revolved method. Editing an element by “tubing” method

With using of the revolved geometry method, it is possible to create objects that have a profile and an axis of rotation: columns, balusters, vases, domes, etc., while the axis of rotation can pass through the profile or at a certain distance from the profile, forming an opening inside (Fig. 4.17).

For construction, you need:

1) activate the “morph” tool and define the method of constructing the “revolved”;

2) draw the contour of the figure in 2D view (on the plan, elevation, section);

3) determine the axis and angle of rotation, as the figure may not be complete.

It is necessary to be precise when drawing the contour, because it cannot be adjusted. To be able to work on the contour in detail, you should use another work algorithm:

1) create a contour from ordinary 2D primitives (lines, semicircles), adjust it to a state when the figure fully meets the requirements. You can use all editing options (rounding, chamfering, adding vertices, etc.);

2) activate the “morph” tool, geometry method “revolved”, move the cursor inside the previously created contour and use the “magic wand” to create a planar morph;

3) determine the line of the axis of rotation;

4) rotate the figure to the desired projection.

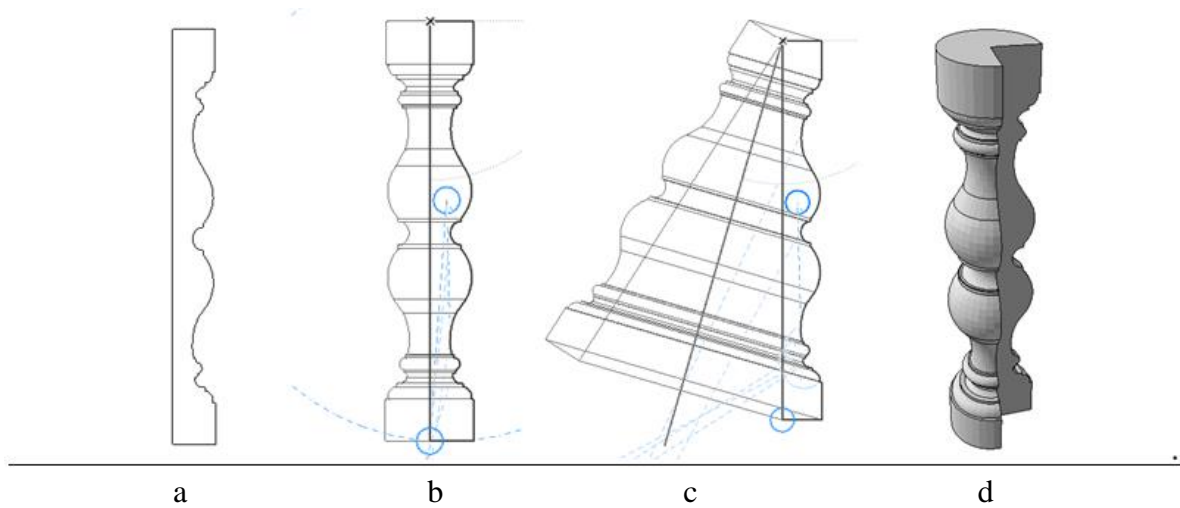


Figure 4.18 – “revolved” morph: a – figure profile; b – the axis of rotation coincides with the profile; c – the axis of the figure does not coincide with the profile; d – a figure with an incomplete radius of rotation



Figure 4.19 – Pavilion in a classic style made with the “morph” using

Tubing the morph along the trajectory

With this editing method, it is possible to create any complex shapes, such as water slides, radial movement ramps, spiral elements, etc. For this you need:

1) draw the extrusion trajectory of the object using 2D primitives. This can be done on the plan or on the elevation. It is permissible to round corners, shift the position of points in all planes, etc.;

2) turn the line into a morph: activate the “morph” tool, use the “magic wand”, click on the line. The created morph will be visible in the 3D projection. After creating

a morph in 3D, it is possible to shift its points (for example, create a spiral from two semicircles by shifting their extreme points);

3) create the contour of the desired morph using 2D primitives, create a planar morph with the help of a “magic wand”;

4) correctly position the planar morph relative to the morph-trajectory. For this, it is better to work in 2D projections because in 3D projection the visual location may be inaccurate;

5) combine the contour morphs of the extraction element and the trajectory into one element;

6) select the extraction face, use the “tube” function to determine the points of extrusion of the morph along the trajectory of movement. For this, it is important to follow the bindings, if they interfere – turn them off, and also position yourself correctly in the 3D view. If the program does not want to draw a contour along the trajectory, try to return to point 4, move the contour morph to another point (for example, instead of the upper point of the trajectory, choose the lower one).

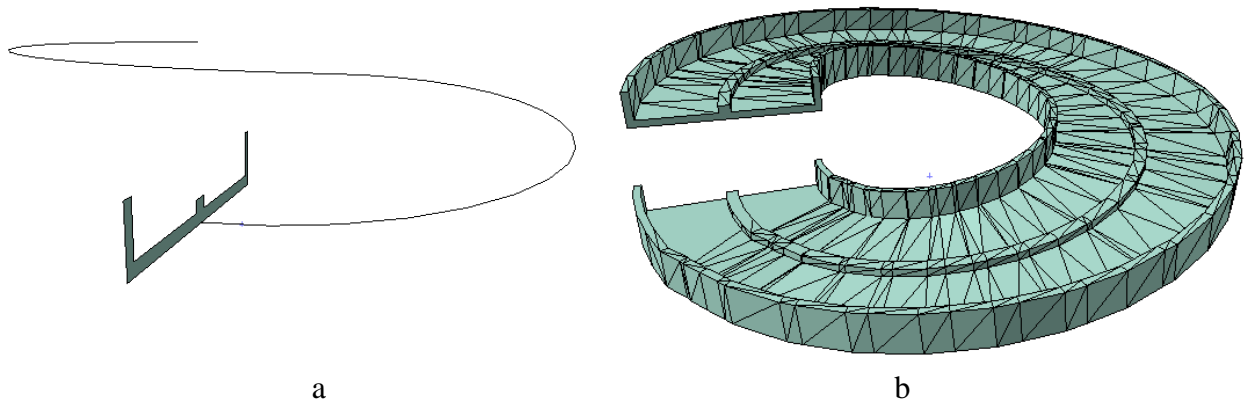


Figure 4.20 – Construction of a ramp using the “tube” method: a – construction of the trajectory and profile of extraction; b – completed ramp

Independent work on the topic

«Methodology of conceptual modeling using the “morph” tool: revolved method. Creating a pavilion in a classic style»

Model a pavilion in a classical style, with Doric columns, a balustrade and a dome. Place the visualization of the pavilion on an A3 sheet with a stamp and a frame.

Construction of urban projects with the help of morph.

Using the texture on the morph

Designing large urban areas requires a lot of effort and technical skills. To simplify the work of creating and presenting a 3D image, designers often use morphs and textures. The texture can be not only the appearance of the material, but also any image, including a master plan drawing or a sketch idea. Thus, when designing the embankment in Madrid (RioMadrid), the architects of West 8 (Netherlands) and MRIO Arquitectos (Spain) used the technique of working with textures. This made it

possible to present the idea without detailed 3D modeling of numerous alleys of the recreation area (Fig. 4.21).

In addition to the fact that each face of the morph can be set to its own texture, its start point and rotation can also be set. Such functions are useful for working with the decoration of interiors, exteriors (elevations), as well as for working with large urban planning projects.



Figure 4.21 – Textures using in the concept of the reconstruction of the RioMadrid embankment

It should be noted that any object: wall, roof, ceiling, etc. can be turned into a morph. To do this, you need to select the object, click the right mouse button and select “convert to morph” from the list.

To change the beginning of the texture, select the desired face, then go to the «Document» – «Creative Imagine» – «Aline 3D texture» – «Set Origin». After that, a red square appears in the 3D window, by moving it you can set the desired location of the texture on the face. The square may appear far from the object. To finish editing, click outside the square. If the size of the image (for example, a picture) does not correspond to the size of the face, you need to change the size of the image in the main texture settings.



Figure 4.22 – An example of overlaying and rotating textures on a morph

To change the texture overlay vector, select the desired face, then «Document» – «Creative Imagine» – «Aline 3D texture» – «Set Direction». By rotating the red square, you can set the desired angle for the texture on the face. Using this, you can create designer decoration of interiors and building elevations.

***Independent work to the topic
«Construction of urban projects with the help of morph.
Using the texture on the morph»***

1. Place the master plan of the microdistrict or block in scale on the plan of the 1-st floor.
2. Create a planar morph according to the shape of the master plan. Draw the contours of buildings on it.
3. Extrude buildings according to their height. If all floors are configured correctly in the program, then the binding to each floor will work correctly when pulling, or you can set the height manually.
4. Create a new “master plan” texture and load the master plan image into it in jpeg format.
5. Give the face that creates the ground level the texture “master plan”, adjust the dimensions of the texture, set the origin of the texture and the vector if necessary.
6. Save the 3D image on an A3 sheet with a stamp and a frame.

Principles of working with the “shell” tool

The shell is a structural element used to create roofs of a specific shape, domes, etc. It stores information about the material, construction (simple, complex multi-layered), surfaces. There are 3 methods of building a shell: extruded, revolved, ruled.

Extruded shells

The extruded shell has two construction methods: according to the specified profile and extraction length, detailed.

To activate the first option, it is necessary to determine the size of the profile (always a semicircle, which can then be modified) and the length of the extraction vector (the length of the extraction of the profile). Shells can be created both on the plan and in 3D. Such a shell can be built in two ways:

- 1) define the starting point of the shell, set the length of the extraction vector, and then the width of the profile;
- 2) determine the starting point, click on it again and then set the arc of the profile (it can also be rotated in the desired direction), and then set the length of the extraction vector with numbers. In this case, the shell will be created vertically and must be rotated in the x-y plane.

The shell has editing functions for both the extraction vector and the profile. Edit the pull vector: stretch, rotate in the x-y plane, tilt the profile, rotate without

reference to the plane. You can also change the location of the pull vector, when the vector line itself (blue, highlighted) seems to be detached from the shell and placed at a certain distance from it.

Editing the profile of the shell: insert new nod, curve edge, offset the edge or all edges, set distortion angle, rotate or drag the profile, etc. (Fig. 4.23).

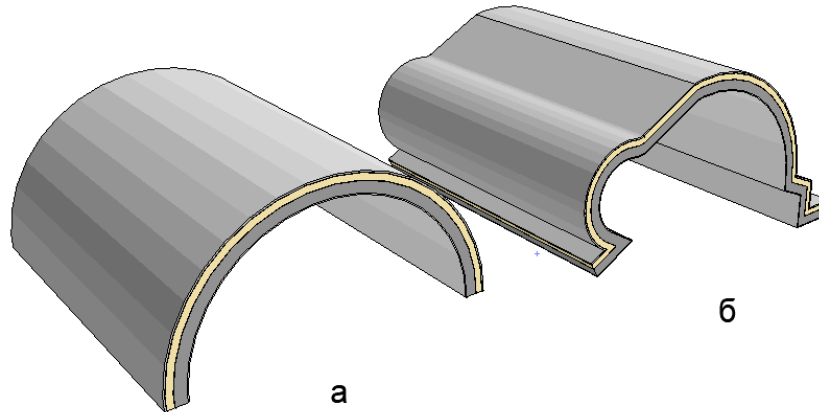


Figure 4.23 – Extruded shell: a – standard version; б – after editing the profile

The “detailed” option allows you to create a more complex profile for the extrusion shell, such as wavy.

1st construction method: call the “shell” tool, draw a complex profile with the given tool using lines and semicircles, click on the last point of the profile and then set the value of the length of the extraction vector (numbers).

2nd construction method: draw the spline of the future profile, activate the “shell” tool, the construction method is detailed, call up the “magic wand” and click on the spline – the program creates a shell profile based on it, the value of the length of the extraction profile is set by numbers (Fig. 4.24). Usually, the shell profile is drawn on the elevation in order to correctly choose the shape of the spline according to the architectural task, however, it is impossible to create a shell on the elevation with the help of a “magic wand”, so the spline must be transferred to the plan, create a shell, turn it into the x-y plane and place it on the building, cut off extra walls.

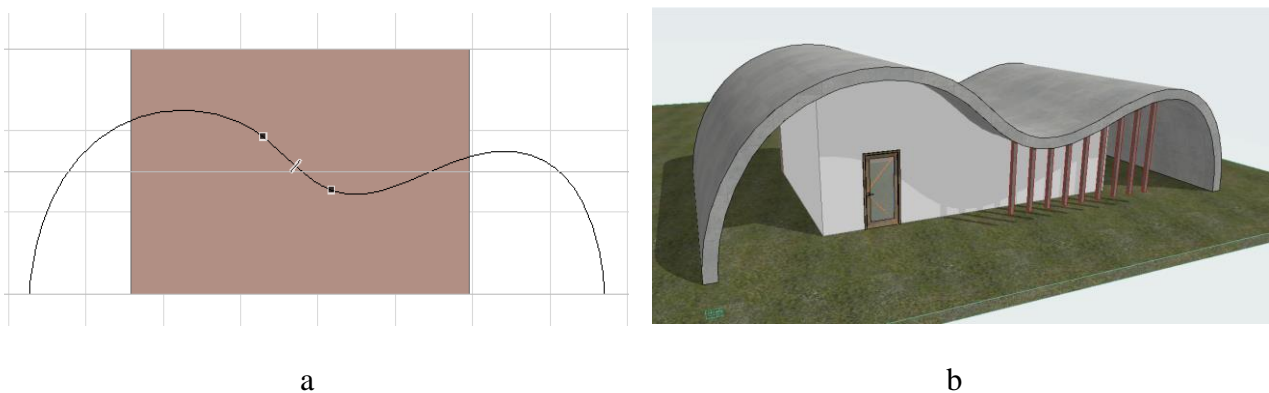


Figure 4.24 – Creation of a complex roof using a shell: a – construction of a contour-spline; б – the view of the finished shell

Such complex variants of the extruded shells are often used to create specific roofs, modern gazebos, and pavilions. That is why the developers added the possibility

of cutting the walls under the shell (it is done in the same way as for the roof). If the command cuts off the walls incorrectly, you need to change the shell settings: in the “cutting body” parameter, choose to stretch the contour down or up, depending on the desired result.

Revolved shells

A revolved shell is created identically to a revolved morph. The only difference is that the shell will have a construction material, and the morph will not. It also has simple and complex construction methods.

A simple method is used to quickly build any domes. To work with it, you need to set the radius of the future profile (dome) and the angle of rotation around its axis. After creating the form, the following modifications are available: shifting its profile relative to the axis, dividing the profile with additional points and faces, rounding these faces provides good opportunities for creating specific forms (Fig. 4.25).

To create a revolved shell using the detailed method, you need to set a complex profile (exactly like for a morph) and specify the axis of rotation.

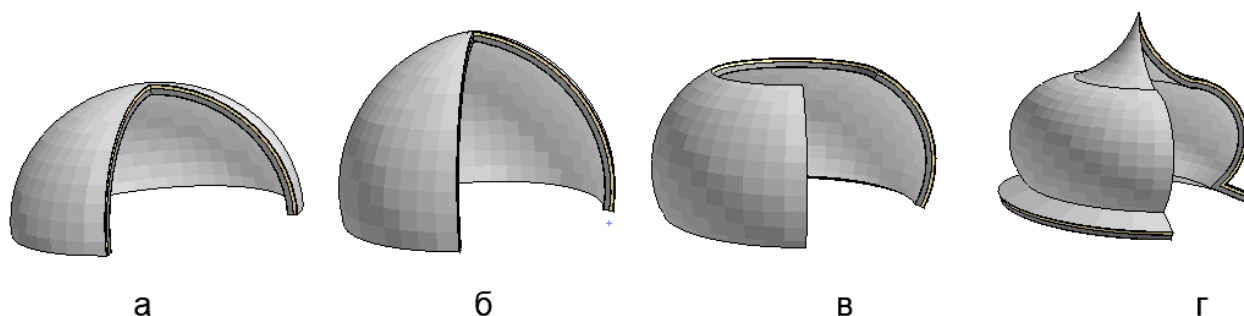


Figure 4.25 – The revolved shell: a – standard construction; б – with the upward point of the rotation vector; B – with an inclined rotation vector; r – with an edited profile

Ruled shells

The ruled construction method allows you to create a shell of a complex shape, which has two different profiles. According to construction methods, there are: simple and detailed.

The principle of building a ruled shell using a simple method: set the width of the first profile on the plan (it will always be in the form of a semicircle), then show the length of the extrusion, draw the second profile (it will always be straight). According to the results, a semi-arch is created, which is often used in temple buildings. After creating the shell, each of the profiles can be edited by making the form as complicated as possible.

Construction of a ruled shell in a detailed way: the first profile is drawn in detail by points, then the equally complex second profile is depicted. This method of construction can connect faces in pairs or smoothed. In addition, spline and “magic wand” can be used to create both profiles. The result is a complex shell that bends in different projections (Fig. 4.26).

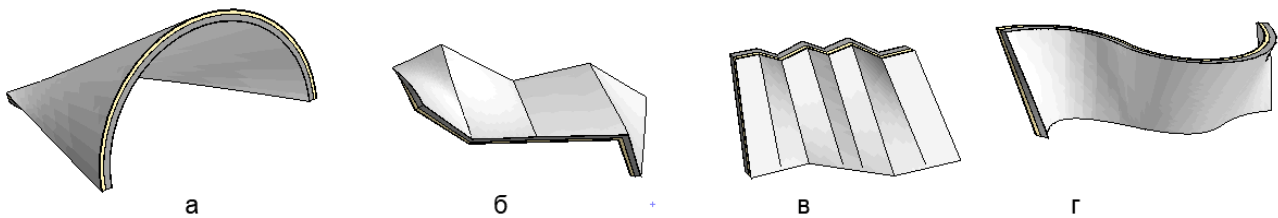


Figure 4.26 – Ruled shell: a – simple method; б – detailed not smoothed; в – detail smoothed; г – made with the help of two splines

Another feature of the shell is that we can give it a different shape after creation, while the shell itself, its size, its profiles remain unchanged, and only its display changes. For this:

- 1) we create a shell using the ruled method according to two complex profiles;
- 2) draw a shape on the plan with 2D primitives (oval, triangle, etc.);
- 3) select the envelope, click the right mouse button, select the option “define shell contour”;
- 4) pressing the “space” on the pre-drawn contour.

The shell will change shape according to the specified contour. At the same time, the contour itself can be selected and moved, which will change the shell. It can also be removed, then the shell will return to its basic form (Fig. 4.27).

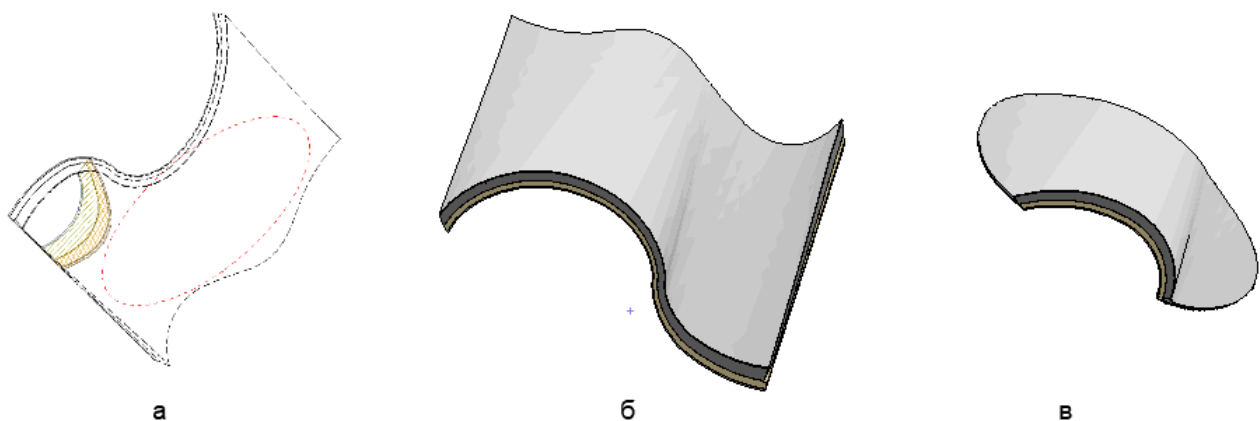


Figure 4.27 – Determination of the contour of the shell: a – on the plan; б – shell before contour change; в – after changing the contour

Rules for placement of skylight and openings in shells

Due to the fact that the shell is used for roofs and specific structures, it is possible to create skylights and openings in it. For this, it is necessary to choose the size and the plane of opening (show graphically). At the same time, when moving the skylight, it will rotate according to the new plane.

To create openings of different shapes, you need to select the shell, right-click and select the function “create hole in shell”, draw the contour of the hole. After that, an editable hole container is created (Fig. 4.28). The shape of the hole can change depending on the point of intersection of the contour with the shell.

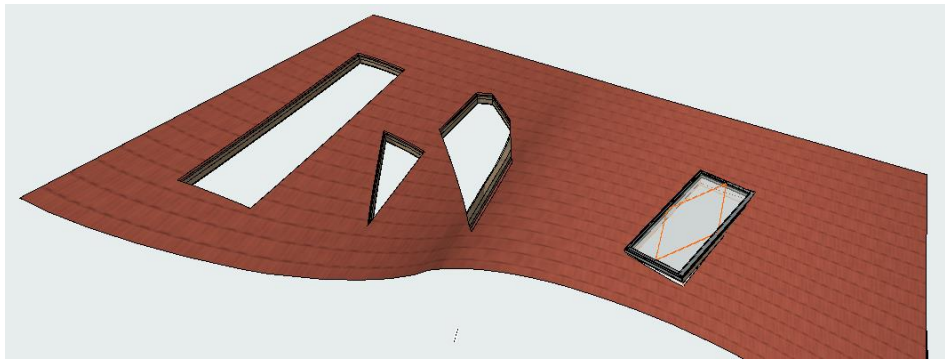


Figure 4.28 – An example of creating skylights and openings on the shell

***Independent work to the topic
“Principles of working with the “shell” tool”***

Create 4 different types of shells: extruded (simple), extruded (by points), revolved, ruled. Edit some of them at your own discretion, create holes in one of them. Place the 3D image on an A3 sheet with a stamp and a frame.

Creation of multi-segment structures of beams and columns

Column and beam are standard structural elements used in most architectural objects. In addition to their main function – a core structure, they are also of great importance for the design of the object. Starting with *ArchiCad 23* we can take full advantage of both of these features by customizing the design and appearance of these elements in their settings. The configuration of columns and beams, construction methods are almost the same. The only difference is that the column cannot be tilted so that it lies in the x-y plane, and the beam cannot be completely vertical. Also, the beam has a special built-in function for placing holes in it. Both elements are easy to build in both 2D and 3D projections.

New methods of editing and placing beams and columns

As with all standard structural elements, setting up columns and beams begins with their placement: determining the location of the floor, binding to the floors, setting the material, setting the image on the plan.

Column construction methods: vertical, with a turn, under an incline, turned with an incline. In the latest versions of the program, it became possible to dynamically edit columns and beams. For example, in the 3D view, you can edit the length, width, height of the element, specifying it graphically. At the same time, you should click on different points, since each point has its own editing capabilities. In this way, it is possible to conveniently adjust the inclination of the column and the connection with other structures graphically, without entering the exact angle of inclination. The function of cutting the column ends at an angle has also appeared. Most often, it is used

for columns that have an inclination in relation to other structures. The “beam” tool received the same editing capabilities.

An important function is the type of relation of the column to the wall structure “wrapping method”:

- 1) freestanding – one that breaks the wall structure;
- 2) wrapped – with this function, the layers of the wall structure, such as insulation and plaster, will be extended around the column. At the same time, only material that is not core flows around the column (Fig. 4.29).

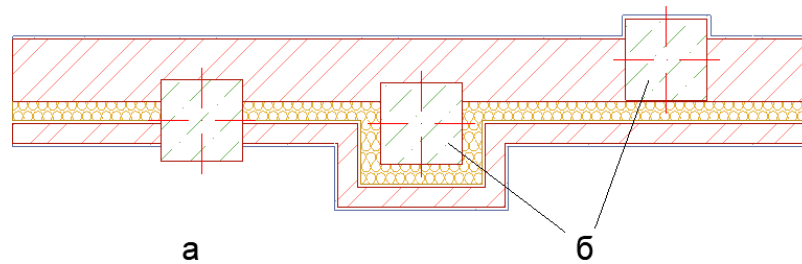


Figure 4.29 – Variants of placement of the column in the wall: a – freestanding; б – wrapped

Creation of segmented beams and columns

The main function that significantly expanded the possibilities of diversifying the forms and designs of columns and beams was the ability to divide these elements into separate segments, each of which can have its own settings for sizes, designs, materials, and profiles. Splitting columns or beams into segments can be done both in settings and graphically in 3D projection.

In the settings, you need to go to the segment settings tab and define the column type as multi-segment. After that, determine the number of segments – they can be added or removed. According to the construction method, there are two options: linear, when the size of each segment is set by a value (numbers), or proportional, when the size is determined by percentages.

Each of the segments can have completely different settings, for example, the lower segment may be square made of brick, the middle one may be round made of concrete, the upper one may have a complex profile. If you choose the round or rectangular cut type of the segment, you can adjust the material and external decoration of the element, if you choose a complex profile – its material will be only the one that was used when creating this profile. That is, it will be possible to change it only in the profile’s settings. You can also change the angle of the connection between the segments. This function is similar to setting the ends. It can be set numerically in the settings, or graphically by clicking on a control point on the connection of segments.

Also, for all types of segments, you can set a variable cut, when it will have one parameter on top (for example, 20 cm), and others on the bottom (40 cm). It also helps to create unique solutions for columns, which significantly improves the image of the entire architectural object. The created column and even its separate segment can be saved as a library element and used in the future (Fig. 4.30).

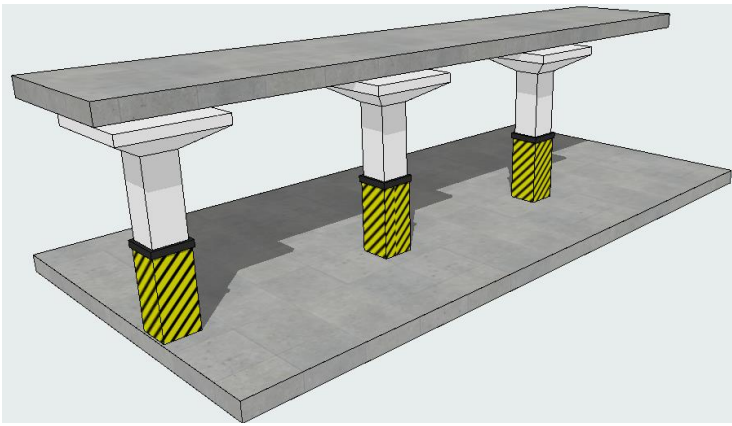


Figure 4.30 – Modeling of a parking column using segments

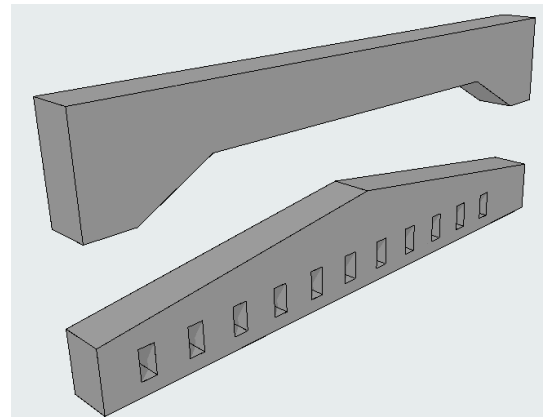


Figure 4.31 – Multi-segment beams

In order to configure a multi-segment column in 3D, you need to select it and select the “edit” function. Without it, you can only adjust the general parameters of the column: tilt, move, duplicate, and others. The “edit” function helps to switch to editing the column itself – segmentation, connections, profiles, etc. When the “edit” function is activated, a large number of control points and an anchor line (blue thick line) appear. To divide into segments, click on the anchor line and select this function. Segments break with binding either to the bottom of the column if clicked closer to the bottom, or to the top if clicked closer to the top.

Also, in 3D, you can perceive the parameters of one segment, such as the lower one, and transfer them to another, such as the upper one. It can also be mirrored with a variable cut.

Beams has an identical editing process. After designing a multi-segment profile for a beam, it can be curved vertically, splitted to the segments and the standard modifications can be performed.

Since beams are always made of heavy materials they might be lightened by the placement of holes, this feature has been included in its editing capabilities in *ArchiCad*. It appears during the editing process in 3D projection. To do this, you need to click on the axis of the beam and select the “insert hole in the beam” function, after which a window for setting the hole, size and location relative to the axis, will appear. The created hole can be edited by working with its control points, duplicated along the length of the column, and the selected hole can be deleted. Holes in the beam can have limited depth and unlimited, cutting through the beam (Fig. 4.31).

Presenting of complex columns and beams on the plan

Depending on the settings, elements on the plan may or may not be displayed. There are three types of mapping: crop, crop and projection below crop, projection and top of element. Different types of display are relevant for inclined columns. You can also adjust the display of material or decoration (Fig. 4.32). To do this, you need to activate hatching, set the type of hatching, pen and background color. In the latest versions, it became possible to place the hatching on the shape of the element, as well as to change the size of the hatching for each individual element using guide lines.

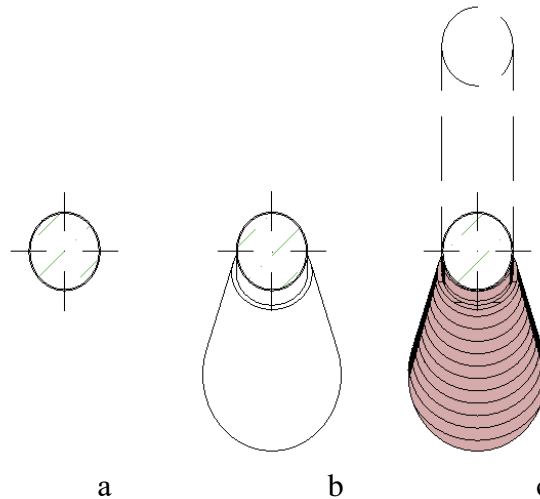


Figure 4.32– Representation of an inclined column on the plan: a – only a section; b – section and downward projection; c – the projection and the top of the column with hatching displayed

CONTENT MODULE 3

Means of modeling the urban environment in urban planning

Practice of working with openings and “wall end” tool

Methods of the opening constructing

Opening is a transparent container that has dimensions and can cut through objects. The opening can be used for the following structural elements: wall, floor, beam, 3D grid, shell. This function is designed to create a variety of openings: skylights and niches in the wall, vertical openings for communications and ventilation, horizontal strobes for laying pipes and electrical wiring.

There are three methods of constructing holes: vertical, horizontal and perpendicular to the base (used when the base has a slope) (Fig. 4.33).

After creating a hole and clicking on its edge, the entire dimensional container of the hole is displayed. It can be much longer in length than the width of the base and cut through several elements at the same time.

Methods of editing openings

Openings can be edited by working with control points and faces. They have standard editing capabilities: fillet a corner, face, insert new nod, curve edge, offset edge or all edges, add or subtract to polygonal. In this way, you can create a sufficiently complex form. Openings can be moved and duplicated.

When constructing an opening, you should pay attention to its anchor line. By changing it, you can create a hole inside the wall or ceiling or partially recessed. Also, the opening can be limited or unlimited. An unlimited opening cuts completely through the base. For limited, we can define the depth of the cut, or limit the visual image of the opening from the bottom and top. With the help of a limited opening, you can create a decorative niche in the wall.

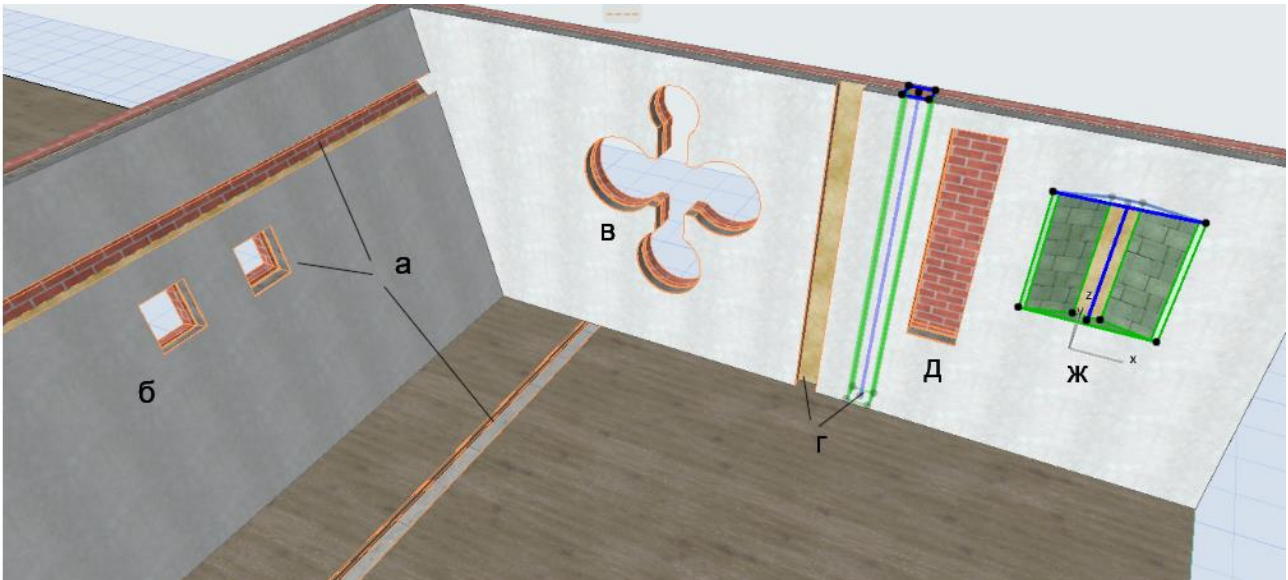


Figure 4.33 – Variants of hole construction: а – horizontal; б – perpendicular to the element; в – perpendicular to the edited form; г – vertical with a different anchor line; д – vertical with a limit on both sides; ж – vertical with restriction and change of shape

Despite the fact that the container of the opening can cut through several objects at the same time, for example, floors, but the opening (as object and symbol) will be created in the floor where it was placed. In order for this to cut through all the elements through which opening is passed, you need to select the opening, click on the square drop-down icon, select + and graphically display the new element (Fig. 4.34). In the same way, you can remove the element and not cut through it with an opening. However, this method is not entirely correct. For example, if one container cuts through three overlaps and at the same time three openings are created, the program will consider them as one hole, because it has one ID.

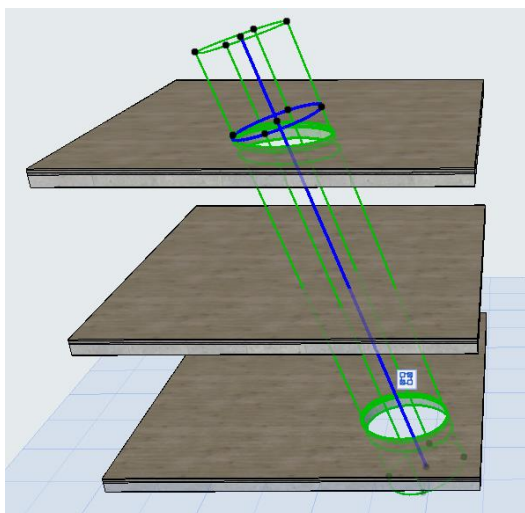


Figure 4.34 – Creating multiple holes using one container

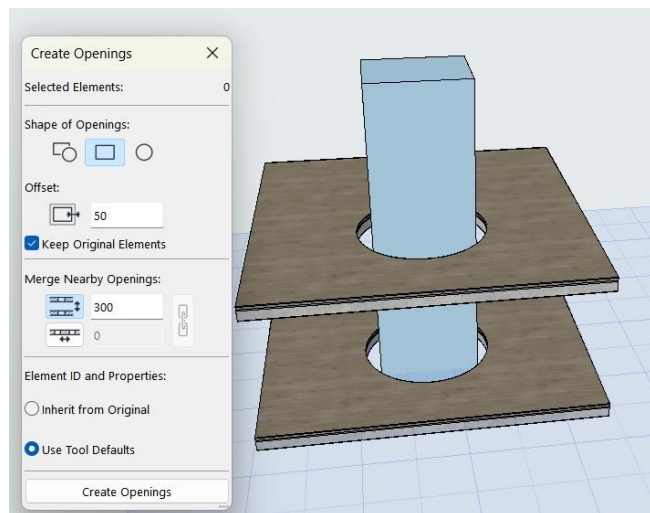


Figure 4.35 – Creating a hole using a morph or object

Openings can be created using a morph and an object. For example, 3 slabs are cut by some morph. To create an opening, select the morph, open the tab «Design» – «Connect» – «Create Openings from Selection». Next, a dialog box appears that offers

methods for creating an opening: keeping the object or not, according to the shape of the object or round, you can also set a certain offset from the morph – expand the opening. The same action is used for objects, for example, an opening can be created with the help of the table or chair (Fig. 4.36).

Presenting of openings on the plan

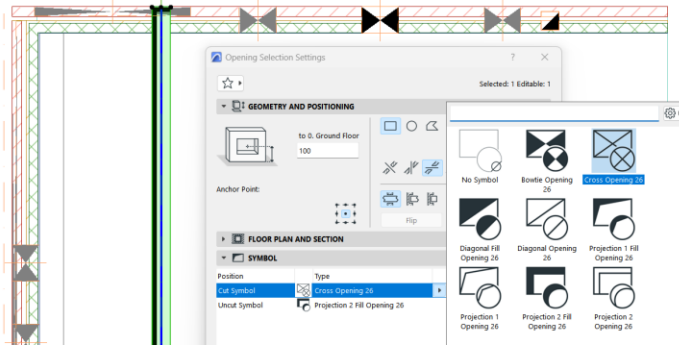


Figure 4.36 – Setting of the opening displaying on the plan

In the opening settings you can also choose options for presenting them on the plan. Symbols are different for vertical and horizontal openings, but in both versions they have the ability to change the shape, width of lines, fills, etc. You can adjust the display of the opening depending on whether it located to the section: placed higher, lower or on it.

Work with “wall end” tool

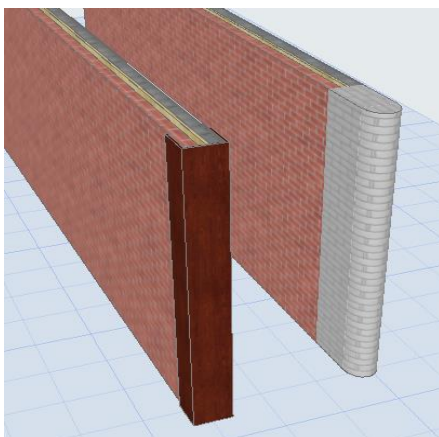


Figure 4.37 – Wall end

Wall end is a special function with which you can create an overlay on the end of the wall. It is most often used when the wall consists of multilayer structures and has an air layer that is visible on the end face, as well as for decorative decoration of the end face. There are several types of wall end: perpendicular, rounded, angle. The wall end can have the form of an overlay on top of the wall, or merge with the wall, continuing its material (Fig. 4.37).

Working with the "zone" tool

General Information

Zone is a solid 3D object that is created inside the room, has dimensions, material and information about it: from the height of the room, area to wall decoration materials, the number of windows in the room and many others. Using zones, you can automatically create an explanation of the premises and mark them on the plan.

On the plan, the zone is marked with a certain color and includes the zone passport. *ArchiCad* contains the main types of zones: residential, office, commercial and others, but you can also create your own zones and edit them. Editing and creation of zones is performed in the «Options» – «Element Attributes» – «Zone Categories».

In this link you can change the name, color and passport of the zone. If the proposed zone passports are not suitable, you can download them from the Internet and apply. A zone passport is .gdl object. To download a passport to a certain zone, you need to go to the tab «*Element Attributes*» – «*Attribute Manager*» – *select the type of element to be edited «Zone»* – *select the desired zone*–*download another zone passport* – *find it on the computer* – *apply and close*. The zone needs to be given an ID number and a correct name, which will be displayed in the explanation.

Zone passport

Zone passport is a table that includes certain information: room number, name, area (net, measured, calculated), floor ceiling markings, and even material. The type of passports depends on the project needs, so there are many types from a circle with a number to indicate apartments to unfolded ones with a complete list of information. Each passport in its settings has its own list of this information, where you can activate or deactivate the items (rows) of the table. The shape and size of the zone passport will depend on these settings. Also, the passport can be customized depending on the scale of the drawing. For example, for a scale of 1:50, a lot of information will be displayed, and for a scale of 1:100, only the room number and area. When changing the scale, the passports on the plan will change automatically. You can also deactivate the “displaying zone passport” function in the model view settings. At the same time, the zone exists on the drawing, but without a passport. It is worth noting that only the passport that was selected in the zone settings in “element attribute” will be displayed and it can be changed only there and only for the certain type of zones, that is, all residential areas of the project have a single type of passport.

Creating of zone

It is better to create zones on separate layers for each floor. This will facilitate the selection of elements for explication. The zone can be created both for rooms and for balconies and attic spaces. Such objects have the specifics of area calculations.

You can build a zone using the parallelepiped or polygonal method, the fastest way is to use the “magic wand”. In the case of flowing spaces, for example, a corridor is combined with a hall, you should build a zone by points. In such cases, you can use a line or spline on the plan that will divide the room into the required number of zones and set the function in their parameters: use as a zone border.

A zone is not automatically displayed in 3D as a solid object. To do this, in the tab «*Document*» – «*Layers*» it must be activated. Also, when editing zones, passports, it is necessary to update the zone in the tab «*Design*» – «*Update Zones*». You can choose all zones or some specific ones. It is worth noting that if the room was divided into two zones and they were created manually using the polygonal method without dividing by lines, then when updating the zone will increase and occupy the entire area

of the room. Zones will not update if the layer they are placed on is closed or if the zone outline is self-intersecting.

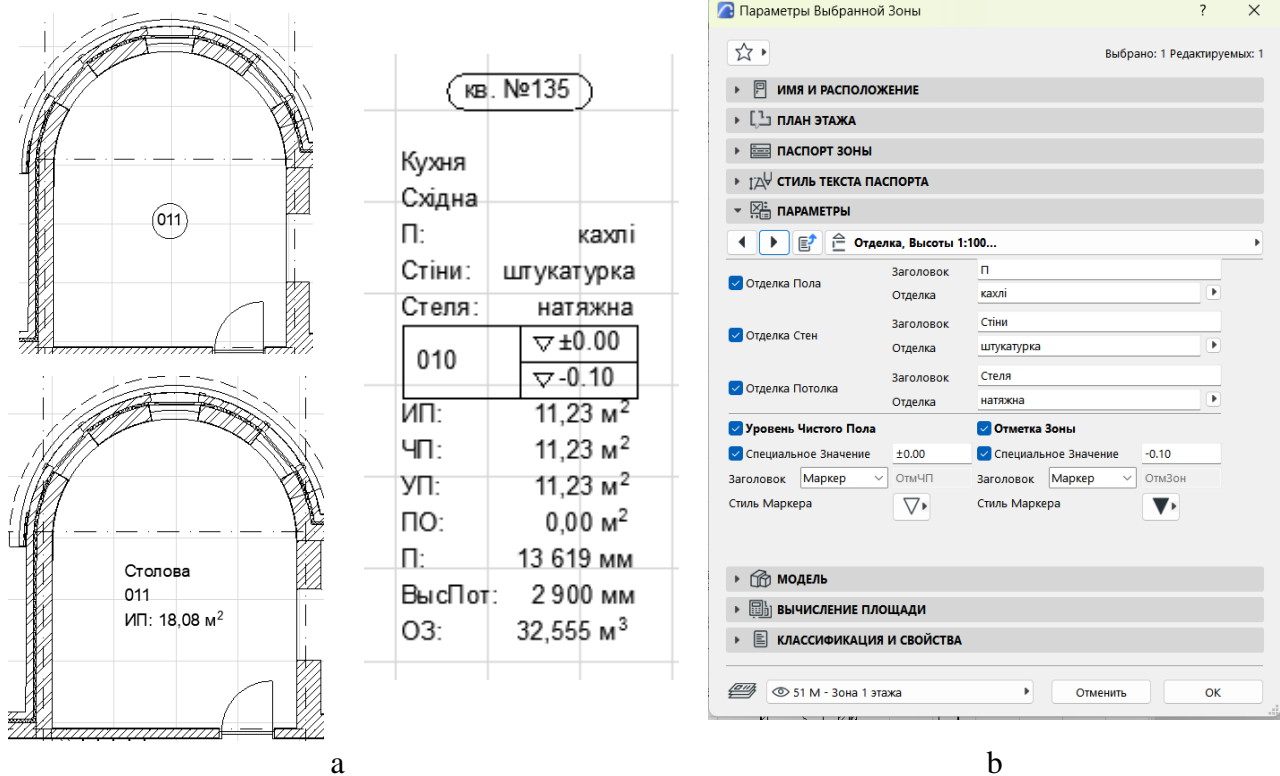


Figure 4.38 – “Zone” tool: a – examples of zone passports; b – zone passport settings

Calculations using zones and creation of an explanation

Rules for calculating the zone area can be edited in the tab «Options» – «Project preferences» – «Zones». In this tab, you can set the rules for calculating the area for attic floors, for window and door openings, for removing columns, walls, and fills from the zone calculation. In order to remove structural elements and fills from the zone, it is necessary in the settings of these elements in «Project preferences» determine the relationship to the zone – remove or activate.

In the standard object schedules, there is an “Object inventory” (explanation) catalog, which has already defined standard parameters. To create an explanation for a new project, you only need to correctly select the elements for it (“zone” object, the name of the layer where the zones are placed).

Thus, the zone is a unique object that helps in obtaining accurate calculations and a wide range of information using schedules.

Principles of working with schedules

Basic information about schedules

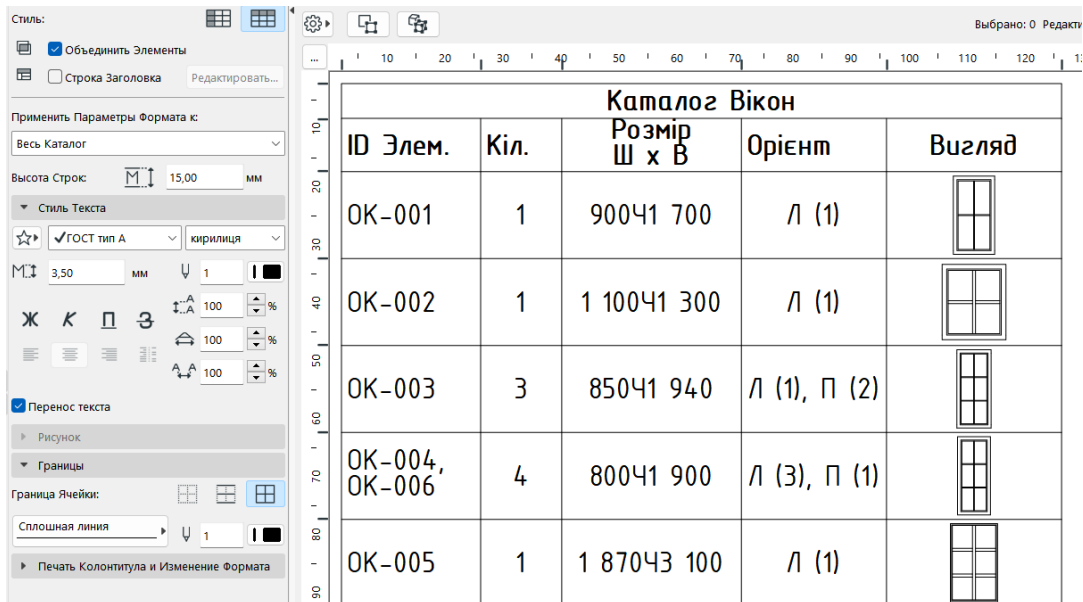
Schedules are information tables that are created according to certain rules using the created 3D model. *ArchiCad* has a set of standard schedules: explanation, catalog of windows and doors, openings, objects (Fig. 4.39).

There are 3 types of schedules:

1) the schedule of objects allows you to count the number and display the parameters of objects in the table: doors, windows, walls (in general: total area, height, etc.), columns, floors;

2) the schedule of components allows you to calculate materials – components of structural elements, multilayer structures (for example, the area or volume of each layer of the structure);

3) the schedule of surfaces allows you to determine the surface of elements, for example, the area of wallpapering, different types of surfaces, etc.



The screenshot shows the ArchiCad interface with a window schedule table titled "Каталог Вікон" (Window Catalog). The table has five columns: "ID Элем." (Element ID), "Кіл." (Quantity), "Розмір Ш x В" (Dimensions W x H), "Орієнт" (Orientation), and "Вигляд" (View). The table contains five rows of window data. To the left of the table is a settings panel for the schedule, including options for "Об'єднати Елементи" (Combine Elements), "Строка Заголовка" (Header Row), and "Применить Параметры Формата" (Apply Format Parameters).






ID Элем.	Кіл.	Розмір Ш x В	Орієнт	Вигляд
OK-001	1	900x41 700	Л (1)	
OK-002	1	1 100x41 300	Л (1)	
OK-003	3	850x41 940	Л (1), П (2)	
OK-004, OK-006	4	800x41 900	Л (3), П (1)	
OK-005	1	1 870x43 100	Л (1)	

Figure 4.39 – Schedule of windows (objects)

Creation and editing of schedules

To create a schedule, make a right-click on the “schedules” tab in the navigator and select “new schedule” and choose its type: for objects, components or surfaces.

The scheme settings include: criteria for identifying the elements, parameters and fields.

There is a common list of parameters, but they can be edited. In the criteria window, we define which specific elements we will work with. For example, we choose the walls of the first floor, which are made of a multilayer structure. To do this, we add new criteria to the main criterion “element”, which must be equal to “wall”. Clicking on “add criteria” opens a window that offers many types of criteria grouped by characteristics: element, placement, display on the plan, etc. We add the indoor “point of the location of the object” and select 1st floor, and also add the criterion

“name of the structure” and select the name of the multi-layer structure in the sample. In this way, we can create a very precise sample of the elements to be calculated. In addition, when adding new criteria, operators appear: “and, or, not” and it is possible to combine certain criteria into groups using parentheses.

After completing work with the criteria window, we proceed to the selection of fields that will be displayed in the table. Depending on the elements that were selected in the criteria, the table of possible fields changes. A window with fields appears after clicking on “add fields”. You can add them from the list by double-clicking the mouse or using the “add” button. How certain parameters are calculated can be deciphered in the *ArchiCad* “help”. It is worth noting that when working with the fields the standard parameters inherent to all objects of this type will offered. Thus, only length and width will be presented for the sofa, although in fact this object has a much larger number of parameters, such as material, type of legs, etc. To use these parameters in the schedule, you need to click on the triangle on the side of the “add parameters” button and go directly to the parameters of a specific object (you need to find it in the library), add them to the table (Fig. 4.40).

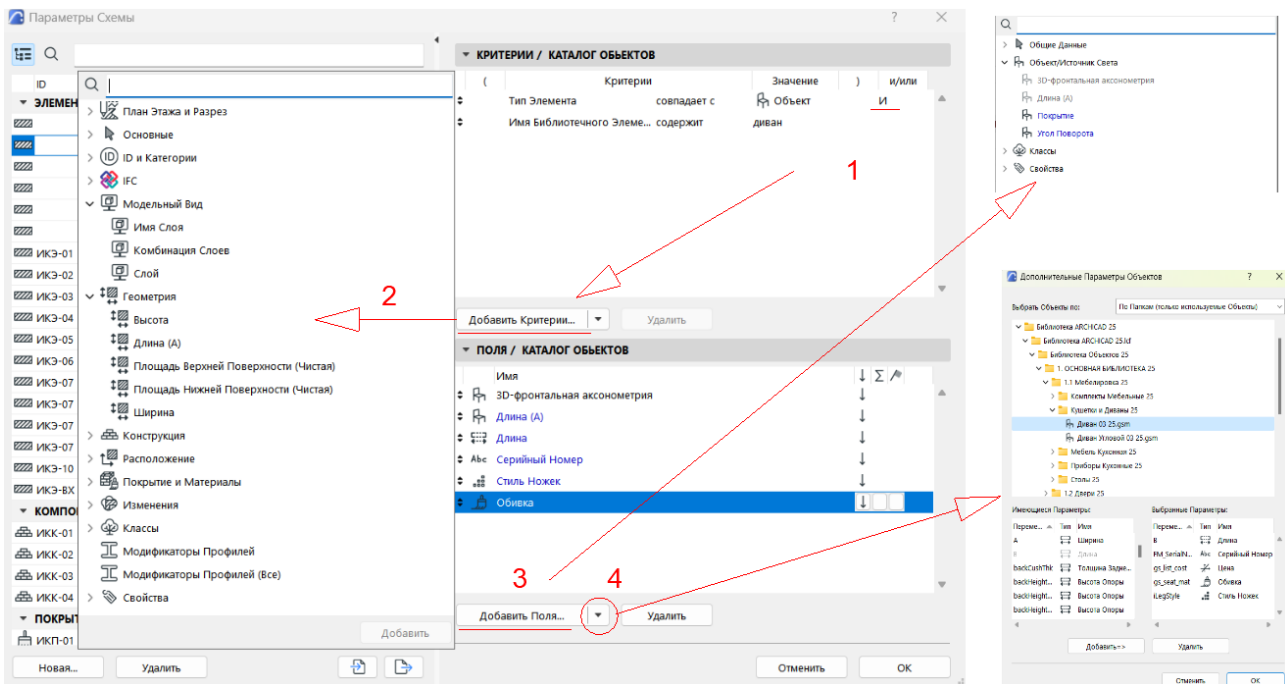


Figure 4.40 – Creation of a schedule: 1 – definition of criterias for selecting elements; 2 – list of criterias; 3 – selection of table fields from the standard list; 4 – additional object parameters

After adding the fields, you need to edit their display: you can change their sequence, add an indicator of the sum of the total (how many windows in total) and intermediate (how many windows of each type), arrange the elements in the table in descending or ascending order. Next, you need to complete the creation of the schedule and go directly to the table by clicking OK.

The table also has a wide range of editing options. You can set different column widths, fonts, combine identical objects. The table is not just a graphic object, but has a direct connection with the 3D model. After selecting an object in the table, you can quickly go to it on the plan or in 3D. You can also edit the object ID in the table. So, for example, to quickly and correctly assign ID to all windows, you can select them on

the plan by activating the “window” tool and CTRL+A, then delete the ID from their parameters. In the interactive table, this column will be empty and already there you can enter the ID for all windows, which will be automatically filled in for the windows on the model. You can also change the material, type of handles and many other parameters in the catalog, which will automatically change the object on the model.

If it is necessary to change the calculation units of this or the parameter, you need to change the settings in the tab «*Options*» – «*Project Preferences*» – «*Calculation Units*».

Work with schedules of components and surfaces takes place according to the same algorithm, but the parameters that can be calculated differ. So, for example, for a wall surface, parameters will appear: surface material, main surface material, replaced surface, etc. In addition, in the table of surfaces, you can delete elements covering the wall elements: moldings, plinths, overlays, etc. For this purpose, an additional “reduce area” button will appear on the side in the scheme parameters during area calculations. With its help, you can determine the conditions and which elements need to be removed from the area calculation.

Practice of preparing basic drawings for printing

Working with groups of layers

Model *ArchiCad* includes many different elements: structural, engineering, decoration, furniture, trees, flowers, etc., which must always be placed on separate layers. It is better to finalize the layer structure for a specific project, and remove unnecessary layers. For example, instead of a single layer of “column”, it is better to use several “structural columns of the first floor”, “decorative columns”, etc. This will allow you to quickly and efficiently preparing drawings for saving in the “view map”. It is also possible to create a group of layers, for example “roof structure”, which would include only layers with roof elements and turn them on and off simultaneously without selecting each layer from the list. So, you can create groups of layers: “construction”, “furnishing”, “visualization”, “reconstruction”, “earthworks” and many others, which will speed up switching between different works. To create a group in the layer editor, you need to select (make visible) only those layers that will be part of the group and click “create group” in the left column, define its name. But, when the project has a lot of layers, it takes a long time to turn them off through the panel. To speed up the process, you need to activate the “layers” panel. To begin with, we make all the layers in the project visible, and then, with the help of the panel and one of its options – “turn off the selected layer”, we select an element in the 3D view that we do not need in the future group and turn it off. We carry out such work until only the necessary layers remain open, we create a group from them. Switching between groups takes place in the left column of the layers panel, individual layers in the right column. So, by creating and activating the “1st floor plan” layer group, we will quickly prepare the drawing for printing.

Model View

The next point is the detailing of the plan. This is an opportunity to depict elements of windows, doors, stairs, fences, beams and other elements of the model in varying degrees of detail depending on the scale of the plan. So, for example, in a scale of 1:50, windows will have the thickness of glazing and frames, in a scale of 1:200, they will be depicted with only one line. You can adjust the details in the tab «Document», «Model View».

Possibilities of “Graphic Overrides”

Graphic Overrides is a function that allows you to change the display of elements on the drawing (pen color, type of fill, etc.) for a specific task without changing the settings of the elements. So, if without graphic override the walls have an orange outline, and the fill is of a different color depending on the material, then after setting and activating the graphic override, the plan drawing will automatically change color to black and white, for the dimensional plan, the wall fill can be changed to solid black or dark gray without displaying the layers of materials, for the reconstruction plan, highlight load-bearing, dismantled and new structures in different colors, etc. You can create many combinations of graphic override and switch them depending on which drawing is being prepared for printing. The setting of this function is in the tab «Document» – «Graphic Overrides».

A combination of graphic override includes rules. Each rule in the settings includes the element whose display will be changed and the style of the graphic replacement (new display). The element is selected in the same way as when creating schedules. Override styles include: override of line type, pen, fill and even surface. In *ArchiCad* there is a set of rules, but you can create new ones and use them in your own graphic override combinations.

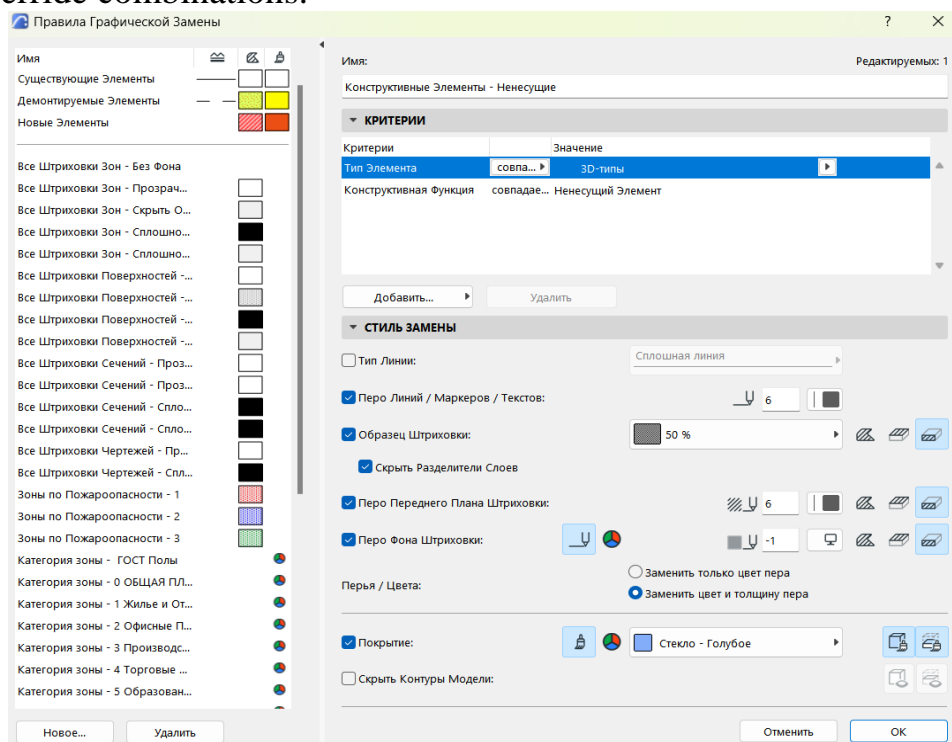


Figure 4.41 – Graphic replacement rules creation panel

Creating your own document template

When loading the program, the document template with which the program will work is always indicated in the drop-down window. A template is a set of settings specific to a certain project: layers, floors, settings of all drawings (graphic override, model view, etc.). Thus, when executing projects, it is advisable to adjust these parameters, remove unnecessary ones, and create your own templates that can be used when executing the next similar project. To create a template, you need to create a copy of an already completed project, remove all elements from it, both in 3D and 2D. To do this, you need to activate (make visible) all layers of the project and delete all elements on the plans, except for elevations, save as a project template *ArchiCad* to the specified folder. Then, the next time you open the program, you need to select the created template.

Independent work for content module 3

"Means for modeling the urban environment in urban planning"

Develop and set on A3 paper the master plan of the site, plans, section, elevations and visualization of the building is made at Architectural Design lesson.

LIST OF RECOMMENDED SOURCES

1. Methodical recommendations for practical classes and organizing independent work on an academic discipline “Software tools for designing objects in an urban environment” (for second-year full-time foreigner students first (bachelor’s) level of higher education specialty 191 – Architecture and town planning) / Viktoria Hryshyna ; O. M. Beketov National University of Urban Economy in Kharkiv. – Kharkiv : O. M. Beketov NUUE, 2023. – 47 p.
2. Help ArchiCAD 25 [Electronic resource] : site. – Electronic data – Updated constantly. – Access mode: <https://help.graphisoft.com/AC/25/RUS/index.htm#t= AC25 Help%2F001 ACHelpIntro%2F001 ACHelpIntro-1.htm>, free (application date: 29.07.2023). – Title from the screen.
3. Architecting Modern Data Platforms: A Guide to Enterprise Hadoop at Scale : tutorial / Jan Kunigk, Ian Buss, Paul Wilkinson, Lars George. – California (USA) : O’Reilly Media, 2019. – 636 p.
4. Sulbaran T. Introduction to ArchiCAD: A BIM Application : tutorial / Tulio Sulbaran, Mohd Shiratuddin, Shane Germany. – New York (USA) : Delmar Cengage Learning; 1. Edition, 2010. – 528 p.
5. Atkinson D. LightWorks in ArchiCAD: The Things You Need to Know : tutorial / Dwight Atkinson. – London (England) : Beginner-No-More Publishing, 2005. – 208 p.
6. ArchiCAD for AutoCAD Users Paperback : tutorial / Scott MacKenzie, Simon Gilbert, Geoffrey Moore Langdon [and others]. – Budapest (Hungary) : GRAPHISOFT R&D, 2008. – 76 p.
7. Nicolson-Cole D. Object Making with ArchiCAD: GDL for Beginners : tutorial / Devid Nicolson-Cole. – Budapest (Hungary) : GRAPHISOFT R&D, 2000. – 110 p.
8. MacKenzie H. ArchiCAD 19 – The Definitive Guide : tutorial / Scott H. MacKenzie, Adam Rendek. – Birmingham (England) : Packt Publishing, 2010. – 295 p.
9. Visualization in Archicad [Electronic resource]. – Electronic text data – Access mode : <https://uk.soringprepair.com/visualization-in-archicad/>, free (application date 05.10.2022). – Title from the screen.
10. BIM objects [Electronic resource]. – Electronic data – Access mode : <https://www.bimobject.com/ua>, free (application date: 18.07.2023). – Title from the screen.
11. Organizing the workspace and creating a project template in ArchiCad [Electronic resource]. – Electronic data – Access mode : <https://graphisoft.com.ua/otkryvaja-zanovo-organizacija-rabocheho-prostranstva-i-formirovanie-shablona-fajla-proekta-v-archicad/>, free (application date: 27.05.2023). – Title from the screen.

APPENDIX A



Figure A.1 – Independent work to the topic
 “Techniques for creating a complex landscape and infrastructure on it”

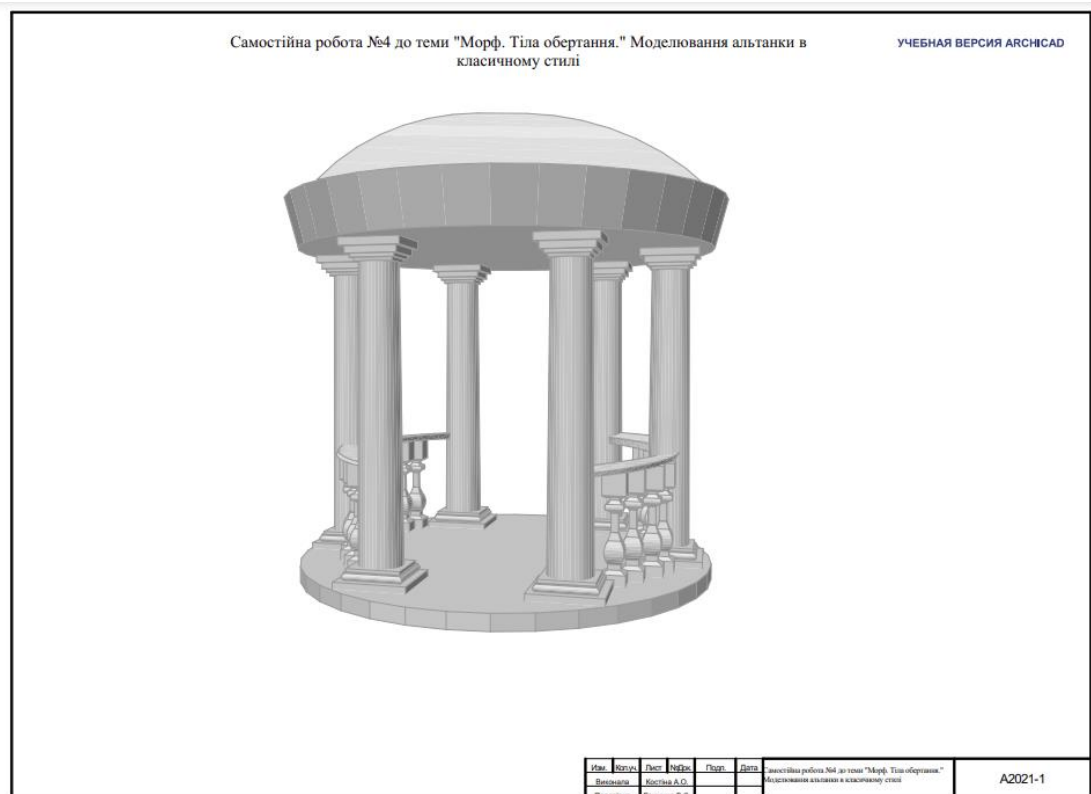


Figure A.2 – Independent work to the topic
 “Methodology of conceptual modeling using the “morph” tool: revolved method. Creating a pavilion in a classic style”



Figure A.3 – Independent work to the topic
“Construction of urban planning projects using morph. Using texture on morph”

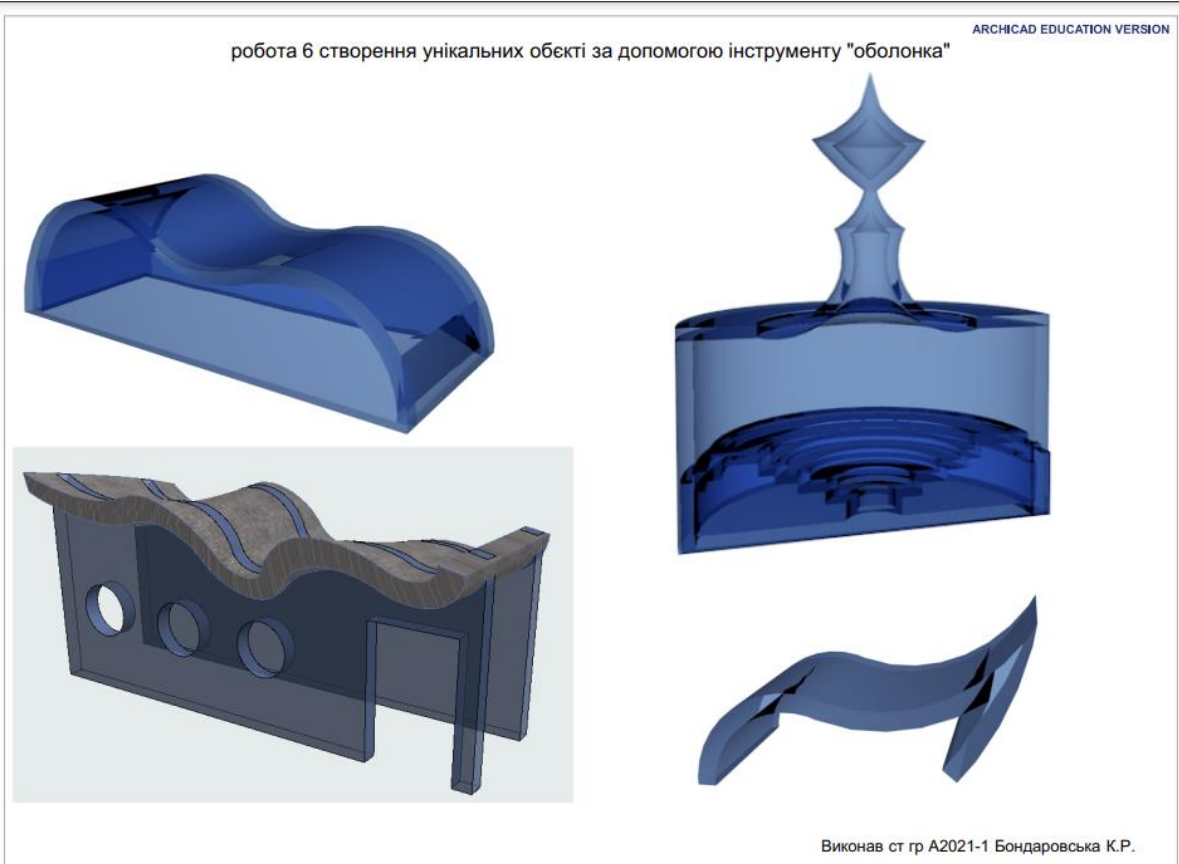


Figure A.4 – Independent work to the topic “Principles of working with the “shell” tool”

Електронне навчальне видання

Методичні рекомендації
до проведення практичних занять та організації самостійної роботи
з навчальної дисципліни

**«СИСТЕМИ АВТОМАТИЗОВАНОГО ПРОЄКТУВАННЯ
У МІСТОБУДУВАННІ»**

*(для здобувачів першого (бакалаврського) рівня вищої освіти
денної форми навчання
зі спеціальності 191 – Архітектура та містобудування))*

(Англ. мовою)

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