MINISTRY OF EDUCATION AND SCIENCE Of UKRAINE

**O. M. BEKETOV NATIONAL UNIVERSITY
of URBAN ECONOMY in KHARKIV**

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)*

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O. M. Beketov NUUE
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Reviewer

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CONTENT

INTRODUCTION

The discipline "Software Tools for Designing Objects in an Urban Environment" is intended for students of the first (bachelor) level of full-time higher education in the specialty 191 – Architecture and urban planning. The discipline consists of 6 topics that consistently teach students how to design using software tools, which is very relevant at the present time. In this course, students gain knowledge of the basics of computer modeling in the *Graphisoft – ArchiCAD* software, which will enable them to apply the knowledge gained in the future to perform practical and diploma works in the discipline "Architectural Design" throughout their further education and to actively use computer modeling tools in practical activities after graduation, creating both small architectural forms and large urban complexes.

The **purpose of the discipline** "Software Tools for Designing Objects in an Urban Environment" is to teach students the methodology of architectural design of buildings and three-dimensional structures, creative methods of broadcasting the author's architectural idea, stimulation of innovation, methods and means of compositional modeling, methods and technologies of energy and resource-saving architectural design, methods and technologies of computer and model design. Also, the goal is Learn to define, analyze and use the compositional regularities of architectural and design shape formation. The task of studying the discipline "Software tools for designing objects in the urban environment" is to master practical skills and methods of software modeling of urban environment objects, to learn to create and visualize basic 2D-drawings and 3D-models of architectural objects, urban planning complexes using *Graphisoft – ArchiCAD* software.

The subject of the discipline is the objects design by means of computer modeling.

Applicants must be able to: use acquired knowledge and skills in project activities; have competencies: implementation of project solutions, particularly drawings and 3D-modeling using *ArchiCAD* software.

Practical lessons are developed on the basis of step-by-step study and practical implementation of project tasks. Acquiring knowledge about the main software tools and methods, as well as the norms for the design of working drawings. Practical work is carried out in the form of consecutive tasks followed by the creation of an album of drawings.

An independent form of studying the discipline based on series of practical and graphic tasks on topics learned in practical classes.

1 CONTENT OF THE ACADEMIC DISCIPLINE BY CONTENT MODULES AND TOPICS

1.1 Formulation of the subject

The discipline "Software tools for designing objects in an urban environment" consists of three content modules, which are divided into educational topics.

The subject of the course corresponds to the basic knowledge, the basis of computer modeling for the formation of objects in the urban environment. The graphic tasks that students perform according to the course correspond to the topics of practical classes in this discipline in the specialty "Architecture and Urban Planning". The student must know the techniques, methods and tools of architectural design and modeling to create high-quality and correct drawings and images to reflect the architectural design.

1.2 Program of academic discipline

Module 1 Software tools for designing objects in the urban environment.

Content module 1 Planar composition. Work with digital images, vector graphics in the program.

Topic 1.1 Interface and working area settings.

Topic 1.2 Learning tools for creating two-dimensional objects and drawings.

Topic 1.3 Practice of building drawings according to dimensions.

Content module 2 Two-dimensional modeling and the basis of 3D-modeling of objects of the urban environment.

Topic 2.1 The practice of creating structural elements of a building.

Topic 2.2 Practice of creating composites, materials and surfaces. Work with complex profiles.

Topic 2.3 The practice of windows and doors placement in a building.

Topic 2.4 Practice of stairs and ramps creating.

Topic 2.5 The practice of roofs creating.

Content module 3 Two-dimensional modeling of master plans and 3D-design of landscape objects.

Topic 3.1 Study of the master plan elements. The practice of relief creating.

Topic 3.2 Practice of creating of elevations and sections drawings.

Topic 3.3 The practice of saving drawings in the view map. Save the album for printing.

2 EDUCATIONAL PROCESS STRUCTURE

The educational process structure contains three modules that are divided into topics. A detailed plan of topics is presented in table 1.1.

Table 1.1 – Topics of practical classes

Topic	Contents (plan)	Number of aud. hours**
1	2	3
Module 1 **Software tools for designing objects in an urban environment**		
Content module 1 **Planar composition. Work with digital images, vector graphics in the program**		
Topic 1.1 Interface and working area settings	1. Introduction to *ArchiCAD* and its capabilities. 2. Installation of the original version *ArchiCAD Graphisoft* on the PC. 3. Interface and working area settings. 4. The practice of drawings placement on the layout and saving them in pdf	1
Topic 1.2 Learning tools for creating two-dimensional objects and drawings	1. Work with "Grids and Background". Absolute and relative coordinates. Principles of construction of 2D-elements: line, circle, polyline, spline, fill. 2. Practice of creating and editing 2D-primitives. Guide lines. Practice of creating a detail drawing. 3. "Multiply" editing method. Practice of creation of concert hall	3
Topic 1.3 Practice of building drawings according to dimensions	1. Study of "wall", "slab" tools. 2. The practice of creating a plan of an object according to a dimensional plan	1
Content module 2 **Two-dimensional modeling and the basis of 3D-modeling of objects of the urban environment**		
Topic 2.1 The practice of creating structural elements of a building	1. Work with images and drawings in *ArchiCAD*. 2. "Greed system" tool. Story settings. 3. Construction of walls and slab on the 1st story. Copying elements on floors. 4. Working with layers	1
Topic 2.2 Practice of creating composites, materials and surfaces. Work with complex profiles	1. Work with interface of the composite construction creator. 2. Creation of new materials. 3. Creation of new surfaces. 4. Work with complex profiles	1

Continuation of table 1.1

1	2	3
Topic 2.3 The practice of windows and doors placement in a building	1. Studying the features of the "door" and "window" tools. 2. Practice of selecting, adjusting and placing doors and windows in the cottage	1
Topic 2.4 Practice of stairs and ramps creating	1. Learning tools: stairs, ramp. Creating and editing new stairs. Railing construction	1
Topic 2.5 The practice of roofs creating.	1. Learning the "roof" tool. Types of roofs, construction, construction methods. 2. Solid modeling operations. Undercutting under a single-plane roof	1
Content module 3 **Two-dimensional modeling of master plans and 3D-design of landscape objects**		
Topic 3.1 Study of the master plan elements. The practice of relief creating	1. Images of buildings and other elements on the master plan. 2. "Mesh" tool. 3. Modeling of relief	1
Topic 3.2 Practice of creating of elevations and sections drawings	1. Study of tools: elevation, section. A practice of drawing creation. 2. Learning the "Worksheet" and "Detail" tools	2
Topic 3.3 The practice of saving drawings in the view map. Save the album for printing	1. Work with the view map 2. Adjust the 3D-image for rendering 3. Saving the album for printing	2

Examples of works are given in Appendix A

3 CONTROL METHODS, THE PROCEDURE FOR EVALUATING LEARNING OUTCOMES

Assessment is carried out according to the cumulative system in three stages: three content modules and final control in the form of a differentiated assessment.

Table 1.2 – The structure of the academic discipline and the score distribution

Content modules	Maximum score			
	everything	practice classes	laboratory classes	independent work
MODULE (semester)	**100**			
Content module 1	**20**	10	–	10
Content module 2	**25**	10	–	15
Content module 3	**25**	10	–	15
Final control	**30**	–	–	–

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

Current control methods:
– performance of practical works using *ArchiCAD* software;
– testing on the MOODLE platform;
– presentation of practical skills of using the program during the implementation of the project 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 is assessed *ArchiCAD* in the current time. 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 scores for each planned learning outcome.

Table 1.3 – Types of tasks and the maximum number of points

Types of tasks and means of control	Distribution of points*
1	2
Content module 1	**20**
Practical work № 1	2
Practical work № 2	2
Independent work on the topic "Work with "Grids and Background". Absolute and relative coordinates"	3
Practical work № 3	2
Independent work on the topic "Practice of creating and editing 2D-primitives. Guide lines. Practice of creating a detail drawing"	3
Practical work № 4	2
Independent work on the topic "Multiply editing method. Practice of creation of concert hall"	4
Practical work № 5	2
Content module 2	**25**
Practical work № 6	2
Practical work № 7	2
Practical work № 8	2
Practical work № 9	2
Practical work № 10	2
Independent work for content module 2 "Practice of creation of cottage plans according to the author's design"	15
Content module 3	**25**
Practical works № 11–12	4
Practical works № 13–14	4
Practical work № 15	2
Independent work for content module 3 "Practice of building facade and cross-section drawings of a cottage. Creating photos of the cottage"	15
Final control – diff. test – graphic design of tasks (format A3); presentation of graphic works.	**30**
Total by module	**100**

Table 1.4 – Grading score: national and ECTS

The total score 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 use *ArchiCAD* software for modeling architectural objects with the involvement of all studied types of tools, performs graphical tasks with high quality and without mistakes, knows how to select tools for the given task, quickly finds solutions for modeling non-standard objects, creative space.

Grade "B, C" – the recipient knows how to model using *ArchiCAD* architectural objects of different complexity 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 work tools.

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

4 METHODOLOGICAL RECOMMENDATIONS FOR THE IMPLEMENTATION OF PRACTICAL AND INDEPENDENT TASK

CONTENT MODULE 1
Planar composition. Work with digital images, vector graphics in the program

Introduction to ArchiCAD and its capabilities. Interface and working area settings

Introduction

The main software product of the company "GRAPHISOFT – ArchiCAD" it is an object-oriented three-dimensional system of automated design, intended for solving architectural and construction tasks. The company has made a revolution, released the first CAD BIM solution for architects in 1984, So far, the developers have presented the 26th version of the program – *ArchiCAD26*.

The package ensures the automation of all stages of design – reference to the area, development of volume-planning solutions and interiors, production of architectural and construction drawings, maintenance of project and estimate documentation, visualization and presentation.

The graphic editor implements the "Virtual House" model – a three-dimensional parametric model from which, in addition to drawings of various types, calculation results and information on quantitative indicators can be obtained, as well as presentation materials can be created. Based on orthogonal drawings, the program automatically constructs an axonometry or perspective, as well as elevations and sections and provides convenient drawing design options.

The program includes built-in libraries of building elements, structures, materials, and light sources. In addition, there are a large number of other developers' libraries, which significantly increases the capabilities of the design. Special formats *ArchiCAD* has the ability to exchange data with other graphic editors, such as AutoCAD*, 3D Studio Max, Artlantis, Rhinoceros, Grasshopper.* Also, *ArchiCAD* software allows simultaneous joint work on the project by a group of developer-architects, speeding up the exchange of data and drawings.

ArchiCAD Interface and "working area"

The program interface includes (Fig. 1.1):

1) the main menu bar (File, Edit, View, Design, Document, Options, Teamwork, Window, Help);

2) "Standard" toolbar – row of command icons;

3) "Info Box" palette – information panel of a tool (the "wall" tool on the example);

4) "Toolbox" (column on the left with all tools);

5) windows of floor, elevation/section, perspective and axonometric images (you can switch between them using hot keys or the navigator);
6) project navigator;
7) image control panel;
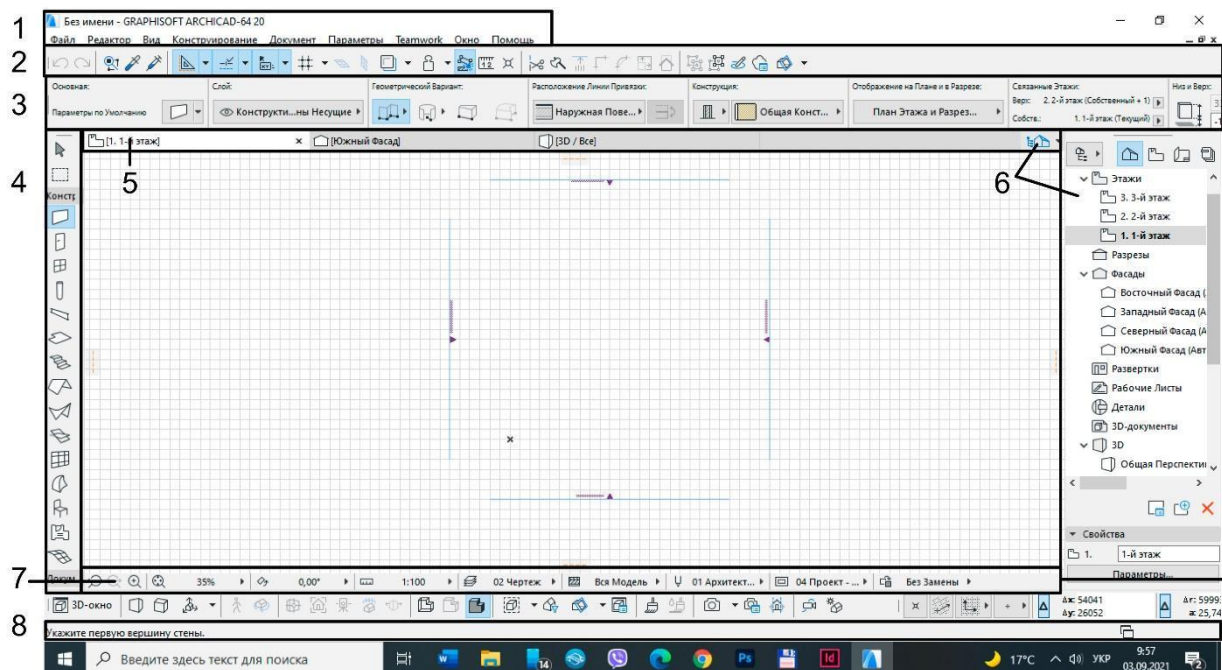8) status bar (provides text prompts during operation).

Figure 1.1 – Program interface

ArchiCAD has a large number of variations in setting up the working area, commands and panels. The working area should be convenient to use during the design and include all the panels necessary to perform the work for quick access to them.

Working area settings

To configure the working area, open the tab *"Window"– "Toolbars"*, activate "3D visualization", "Standard", "Mini navigator". These are the main toolbars of commands that are needed during design.

In the tab *"Window"– "Palettes"* activate the "Toolbox", "Info Box", "status bar", "navigator", "coordinates".

The Toolbox (on the left) can have the appearance of icons with captions (Fig. 1.2), which takes up a lot of space. In order to leave only the tool icons, you should open the tab *"Options" – "Work environment" – "Toolbox"* and deactivate signatures (ABS), as shown in Figure 1.3.
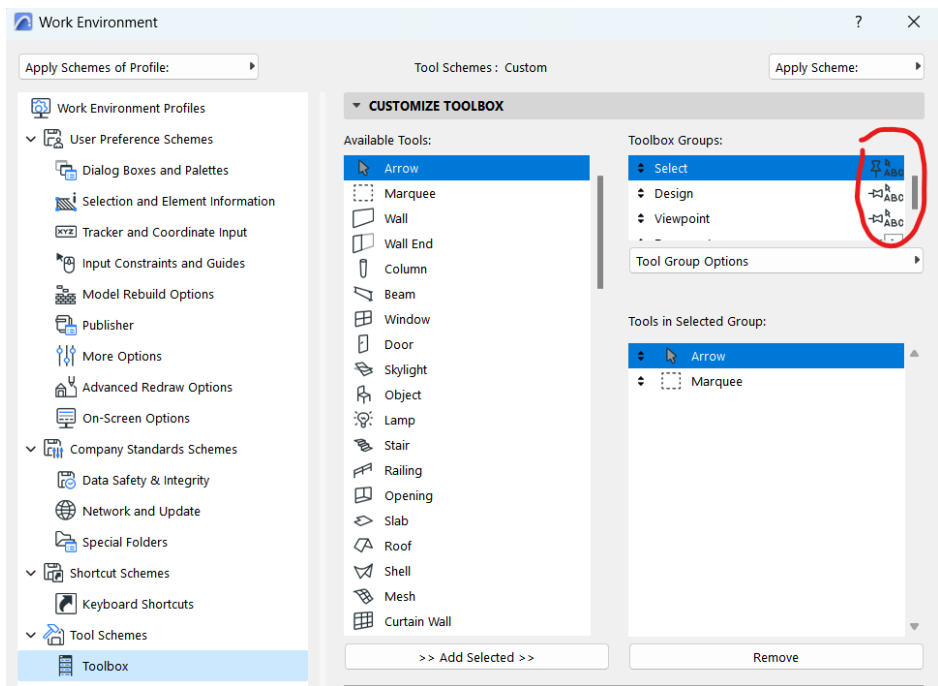
Figure 1.2 – Toolbox

Figure 1.3 – Activation (deactivation) of tools labels

When working, when hovering over the tools, a tooltip appears next to it. If it does not work, but you need it – open the tab *"Help" – "show tool tips"*.

In addition, we can edit the composition of tools on any palette. To do this, go to: *"Options" – "Work environment" – "Toolbars"*.

In the right column select the palette or toolbar in which you want make changes, select the tool you plan to add, OK (Fig. 4).

When you fully customize the interface for your needs, you need to save it. To do this, open the tab *"Option" – "Work Environment" – "Work Environment Profiles"*.

Create a new profile, name it and click OK. Next, select your personal profile and set it as "default".

Only after that, the next time you open the program, the working environment will look like you previously configured it. Otherwise, the default set and default panel placement will open.

In addition, the profile you saved can be moved and installed on another computer if necessary. To do this, open the tab:
"Options" – "Work Environment" – "Work Environment Profiles ", choose the desired profile, click *"Export"*, specify the folder to saving the profile, click OK – export.

To import the profile, perform all the above actions and click "import", indicating from which folder the profile will be imported.

Using keyboard shortcuts for tools activation is convenient when you work in *ArchiCAD*. To set them, open the tab *"Options" – "Work Environment" – "Keyboard Shortcuts"*. Also, you can get the list of shortcuts here: *"Keyboard Shortcut review" – show in browser*.
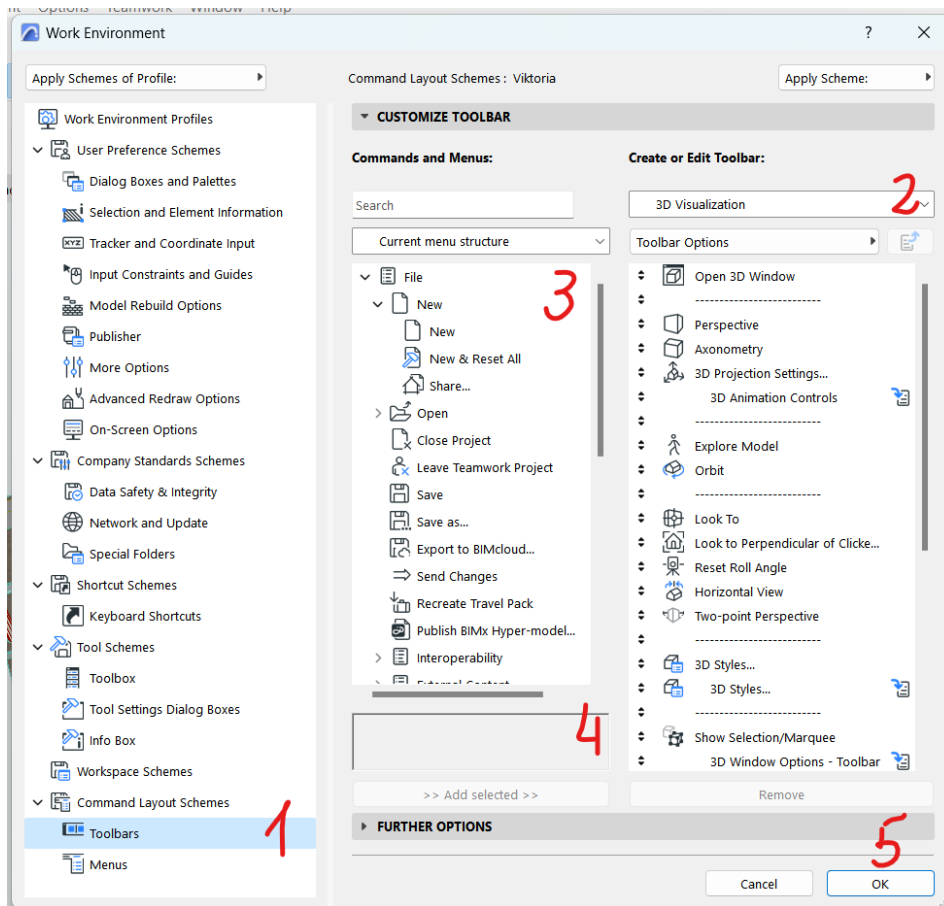
Figure 1.4 – Adding tools to the toolbar

Independent work on the topic
"Introduction to ArchiCAD and its capabilities. Interface and working area settings"

1. Install the program on your laptops from the original *Graphisoft* site: URL: https://graphisoft.com/try-archicad

To do this, you need to create an account *Graphisoft*, noting that you are a student, log in, click on your *ID* and open *MyArchiCAD*.

You can download the latest *ArchiCAD* version from here, take *ID* and "serial number" to install the program. Free access to the program is provided for 30 days. For students, free access can be extended for 1 year. To do this, you need to fill out and send the form, providing your student ID. Each request is checked by site administrators personally, so it may take some time. If access is not provided for a long time, you need to contact the support service.

2. After installing the program, activate all toolbars and palettes presented in the lesson. To the standard toolbar, add the tools: "save" (place first) and "group" (place next to the "Suspend groups" tool).

3. Save your profile and set it as "default".

Learning tools for creating two-dimensional objects and drawings

Work with "Grids and Background". Absolute and relative coordinates. Principles of construction of 2D-elements: line, circle, polyline, spline, fill

Setting up the construction and snap grid

For easier elements constructing in *ArchiCAD* the "grid" auxiliary element is used. These are horizontal and vertical lines with a certain step, which are invisible when printing, but displayed in the working area. There are two types of "grids": construction and snap. The construction grid is usually configured for a large integral size (meter, 10 meters, kilometer, etc.), and the snap grid additionally divides the construction grid into smaller segments (10 cm, 20 cm, etc.). It's better to set up a grid for each specific object. To do this, go to the tab *"View" – "Grid and Editing Plane Options" – "Grids and Background"* (or Shift+F8) (Fig. 1.5).

In addition to resizing, you can also change the angle of the grid, its image in 2D- and 3D-view. In the lower part of the palette there are three options for working with the grid: without anchor, anchoring to the snap grid, anchoring to the construction grid. It is appropriate to activate the same palette in the working area for easy access to it.
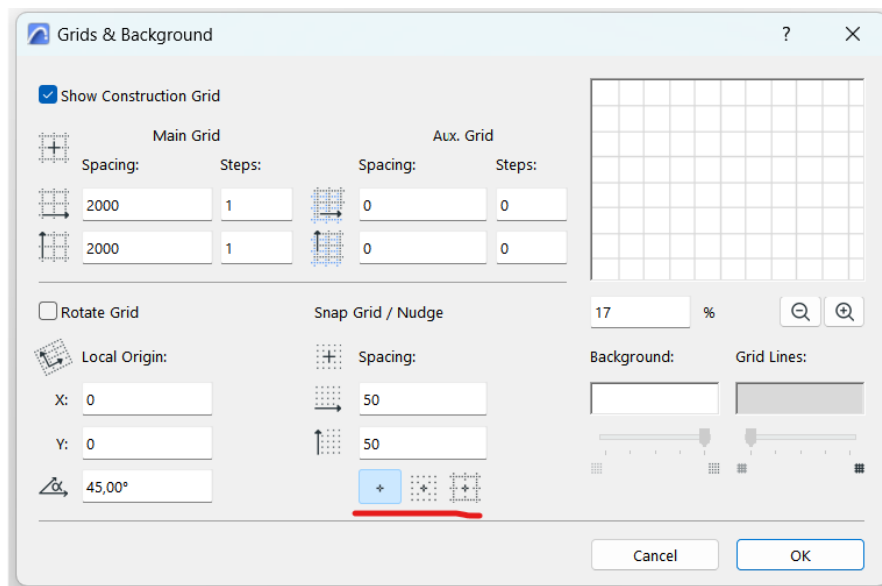

Figure 1.5 – Grid auxiliary element settings palette

Absolute and relative coordinates

In the basis of work with any tool in *ArchiCAD* is a coordinate system. Reference to absolute coordinates means the distance from the beginning of the coordinate grid, which is represented by a cross in the working area, and relative reference is the distance from a certain point. To switch from one system to another, click on the triangle in the lower right corner near the coordinate palette (Fig. 1.6). When switching,

the result of displaying the coordinate indicators on the right will change. Also, it's better to activate "tracker" what is located on the "standard" command palette (Fig. 1.7).
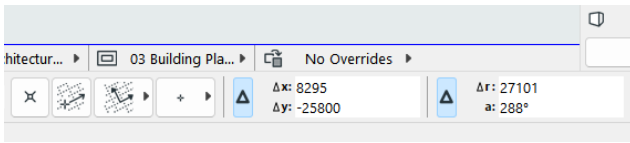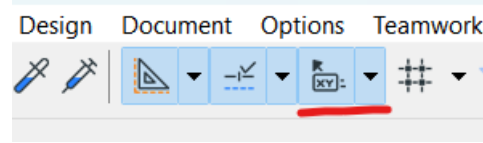

Figure 1.6 – Coordinate palette

Figure 1.7 – Coordinate tracker

Or you can activate it also in: *"Options" – "Work Environment" – "Work Environment" – "Tracker and Coordinate Input*. The *"Show Tracker"* function must be activated.

Principles of construction of 2D-elements: line, circle, polyline, spline, fill

2D-elements are always auxiliary, they can be used to modify 3D-elements.

Each of the tools usually has the same set of commands and construction methods. To create a line, activate the "line" tool. First, you need to specify the first point, then the next. There are two construction options: by coordinates, by direction. The "by coordinates" method assumes that after specifying the first point in the tracker, that will appear automatically, or it can be shown after pressing *x* or *y*, you must specify the coordinates of the next point. Coordinates can have positive and negative values, for example: (x:800; y: -300). In the same window, you can set the angle of the next element relative to the starting point, the radius and the distance. Switching between different options in the tracker is easy using *Tab*. The "by direction" method is usually used in cases where we create lines according to the main coordinate directions: up, down, left, right. We define the 1st point, then move the mouse cursor in the desired direction (for example, to the right), then, without pressing anything, enter the required distance on the keyboard and press Enter. Working with these two options is the same for all 2D- and 3D-tools.

There are 4 Geometry Methods for creation a **line**: single, chained (consists of several segments that are grouped together), rectangular and rectangular rotated. After creation, the editing manipulations can be performed with the line: stretch, drug, rotate, mirror, multiply. This editing palette appears when you click on the nod. When clicking between nodes, commands are added: add a new nod, curve (round) edge, edit segment using tangent. These modifications are the same for other linear tools: wall, beam, etc. When using the "rectangle" method, the lines are automatically grouped and the editing function disappears. In order to be able to continue editing a part from a rectangle, all lines must be ungrouped or suspend groups.

Unlike the line, **polyline** is a single integral element consisting of several segments that cannot be ungrouped. This element has additional editing options: fillet

or chamfer the nod, offset edge, offset all edges, continue polyline. The same modifications are available for other solid objects such as slab, mesh, etc.

Spline is a smooth line built using several indicated points or tangent points, or drawn by hand.

There are 2 variants of **circles**: Arc/circle and Ellipse. A circle can be built using the center and two points, three points, using tangents, an Ellipse - diagonally, semi-diagonally, along the axes.

Fill is a graphic element that has an area, various types of fills to depict planar elements - lawns, coverings, etc. Fills are actively used in muster plans, as well as for the execution of analytical schemes. According to geometrical method fill can be: polygonal, rectangular, and rotated rectangular. For fills, you can set type, fill and background colors, outline, and define its area.

Independent work on the topic
"Work with "Grids and Background". Absolute and relative coordinates.

Task 1

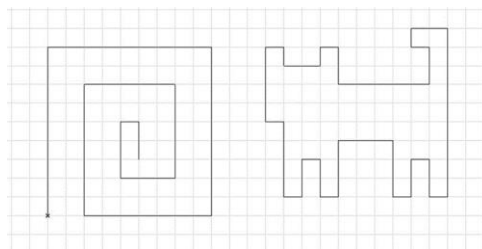Using the "line" or "polyline" tool, draw figures (Fig. 1.9) using a construction grid with a step of 1m × 1 m.

Figure 1.9

Task 2

Draw a figure by coordinates:

1.	(100;0)	14.	(0;200)	27.	(-100;0)
2.	(0;300)	15.	(400;0)	28.	(50;200)
3.	(200;0)	16.	(0;-100)	29.	(50;-200)
4.	(0;-300)	17.	(0;100)	30.	(-100;0)
5.	(500;0)	18.	(-200;100)	31.	(0;-200)
6.	(0;400)	19.	(0;200)	32.	(-200;0)
7.	(-100;0)	20.	(200;0)	33.	(0;200)
8.	(0;-100)	21.	(-100;-50)	34.	(-100;0)
9.	(-100;0)	22.	(100;-50)	35.	(50;200)
10.	(0;100)	23.	(-200;0)	36.	(50;-200)
11.	(-100;0)	24.	(0;-100)	37.	(-100;0)
12.	(0;-100)	25.	(-200;-100)	38.	(0;-600)
13.	(-100;0)	26.	(0;100)		

Format the image on the format A3 and save in pdf.

Practice of creating and editing 2D-primitives. Guide lines. Practice of creating a detail drawing

Work with guide lines and basic editing tools

Before creating of 2D-drawings, you should study the project in detail and develop the most optimal algorithm for its execution. If the element has an axis of symmetry, it is not necessary to draw it completely, but you can create a part and use the editing tool "mirroring", multiplying, rotating the copy, etc.

When designing, "guide lines" are often used – these are special lines that are invisible when outputting to print, but help to form anchor points of elements. Guide lines do not have editing options, are not highlighted when the main working lines are selected, and can be created and deleted only in their own editor located in the "Standard" palette (Fig. 1.10).
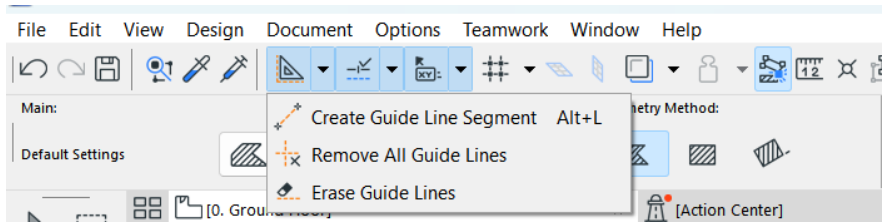

Figure 1.10 – Location of the "guide lines" tool

To the main editing tools, which are inherent to absolutely all objects in *ArchiCAD* are: drug, rotate, mirror, multiply, drug multiply copies (Fig. 1.11).

The editing palette appears when the object is selected and the main methods are shown. A larger set of editing options appears if you click on the object with the left mouse button and select "move" from the drop-down menu. Copy editing and multiplying are important. But you can edit the copy, for example mirror or drug the copy, by selecting the usual drug function and pressing the Ctrl.
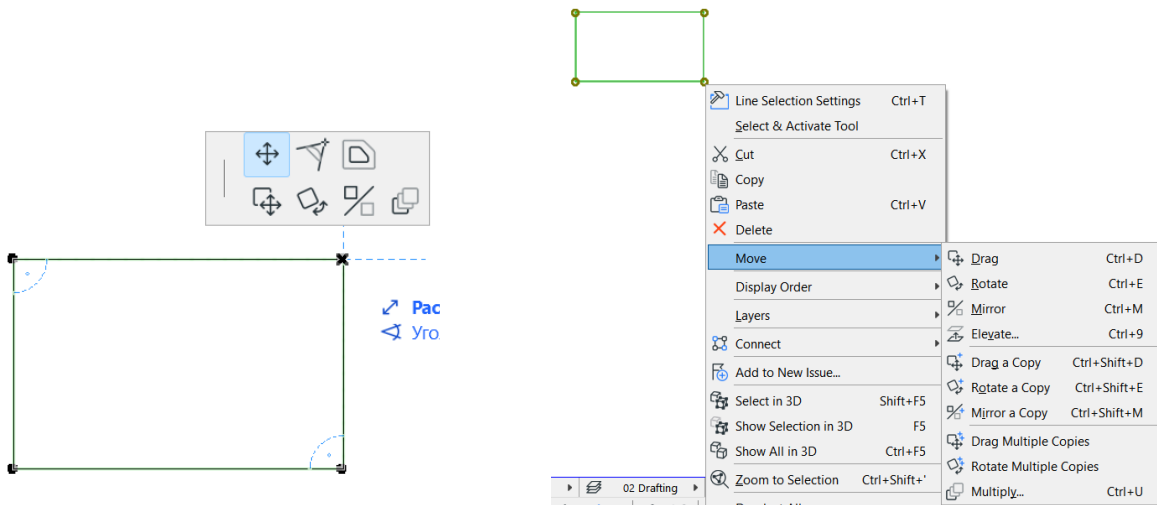

Figure 1.11 – Palette for editing elements: a – small; b – expanded

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If two lines are placed separately and you need to create an angle between them, you can stretch them and "Trim" tool, or select both lines and use the "intersect" tool ("standard" tool bar). You can perform "rounding" and "chamfering" operations with the lines forming the corner (Fig. 1.12).
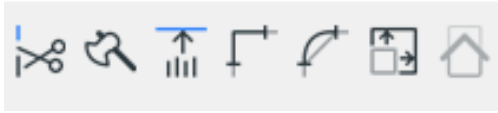

Figure 1.12 – Tools:
1 – trim; 2 – split; 3 – adjust; 4 – intersect;
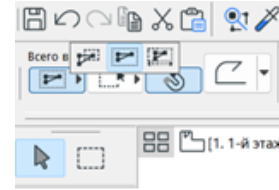5 – fillet/chamfer; 6 – resize

Figure 1.13 – The object selection method selection panel

Types of selection of objects on the drawing

There are two options for selecting objects: directly when clicking on it with the left mouse button and when selecting it with a frame. On a complex drawing, when selecting a large array of elements, it is optimal to use the frame selection, because it has a large number of options.

The selection options palette appears when you click the arrow icon on the toolbar. It includes: selection methods (1 – all that the frame touched; 2 – all that were completely in the frame; 3 – variable: if you draw the frame from left to right, it is highlighted as the 1st option, if from right to left – as the 2nd option); geometrical method of the frame: polygonal, rectangular, rectangular turned. The "quick selection" (magnet) icon helps to select elements that do not have fill (for example, a slab has an outline, but you did not specify fill) by clicking in the middle of the object, and not directly on its outline (Figure 1.13).

Independent work on the topic
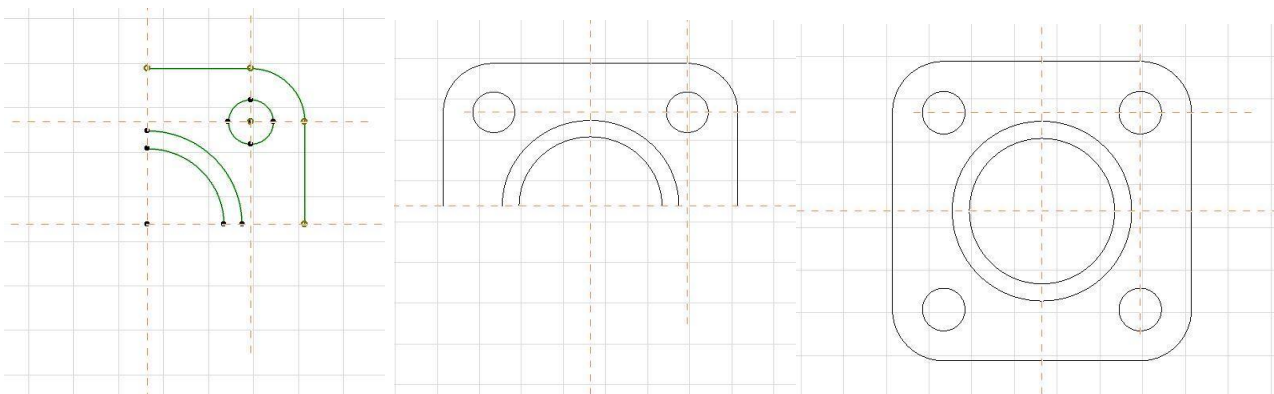**"*Practice of creating and editing 2D-primitives. Guide lines. Practice of creating a detail drawing*"**

Figure 1.14 – The algorithm for creating of detail drawing

Another method of editing objects is "*Multiply*". Unlike others, it has a large number of variations (Fig. 1.15).
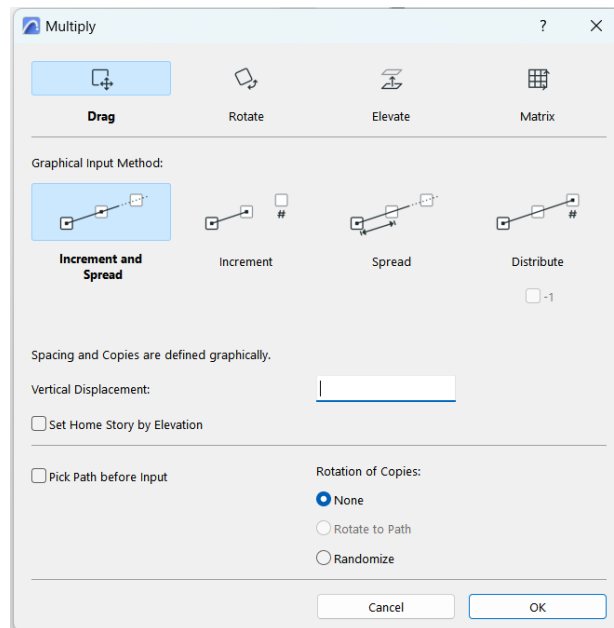

Figure 1.15 – The work palette of the "Multiply" tool

There are 4 types of multiplying: displacement, rotation, vertical, matrix (Fig. 1.16).

Drug – a type of multiplying that works in the x-y coordinate system and work as drug copies of an element in one direction.

Rotate – a type of multiplying that copies element around a given radius (circle) using the distance, or angle, between objects. Two options for placing objects are available: creating duplicates without rotating them, creating duplicates by positioning them to the center of the circle.

Elevate – a type of replication that creates a copy of elements in the z coordinate system. At the same time, some elements may disappear from the plan by moving to other floors. The result of such replication is clearly visible in 3D.

Matrix – a type of replication that allows duplicating an element in two directions as creating a grid of columns.

The "vertical displacement" item allows you to determine the increment of movement of each subsequent copy along z coordinate. In this way, it is possible to model spiral and other types of stairs, etc.

In addition, each type of multiplying has additional graphical input methods:

1.	*Increment and spread* means that you need to graphically specify the distance between the 1st and 2nd object, and the others will be built at the same interval by the direction, the number of elements doesn't matter.

2.	*Increment* needs number of elements and distance between the 1st and 2nd.

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Spread means that the number of elements that we have determined will be evenly distributed at a given distance. And in the variant distribution -1, the same action is performed, but without the last element.

In addition, there is a free method of creating copies "drug multiply copies". It allows you to place any number of elements without any anchoring and distances. For example, it can be used to place trees on a plot, etc.
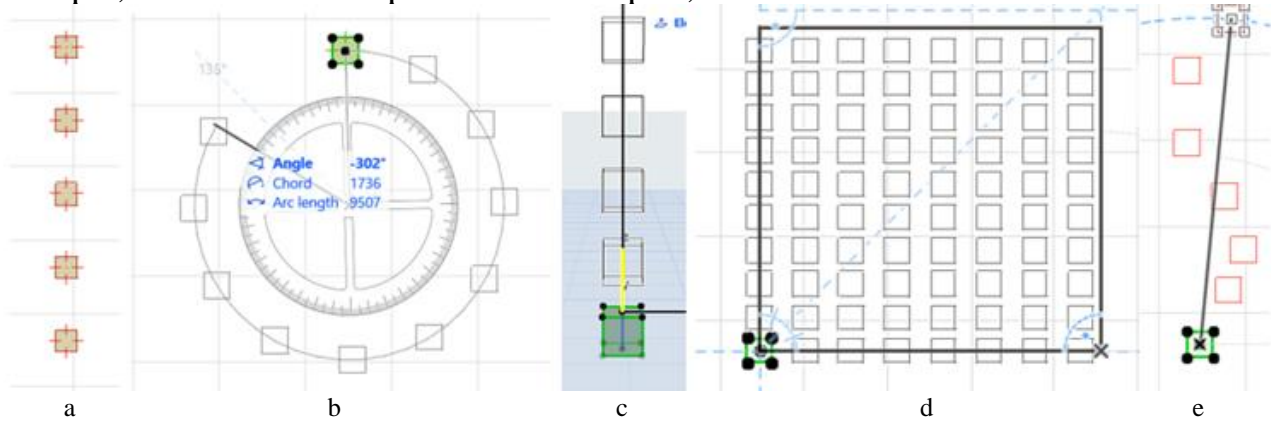

| a | b | c | d | e |

Figure 1.16 – Multiplying types:
a – drug; b – rotate; c – elevate; d – matrix; e – free

Independent work on the topic
"Principles of "replication" editing.
The practice of building a plan of the assembly hall"

Using the editing method "multiply", create a plan of the concert hall and place it on format A3 with a stamp. It is not necessary to specify the dimensions.

Learning 3D modeling tools: wall, floor, beam, column

A **wall** is a linear structural element, which according to the principles of creation is similar to a line, a polyline. This tool has a large number of parameters that are important both for creating a three-dimensional image and for getting the information. There are 4 geometry methods of building walls: straight (single, chained, rectangular, turned rectangular), curved, trapezoid, polygonal (Fig. 1.17).

Walls can also have several types of structure – straight and curved options are used to basic and composite structures, trapezoidal and polygonal only for single ones (Fig. 1.18).

When placed on the drawing, the bottom of the wall is automatically fixed to the story on which the design is carried out, and the top to the upper story. Thus, with the correct setting of the floors, the height of the wall is determined automatically. But it can also be adjusted by setting "not linked" or another story.
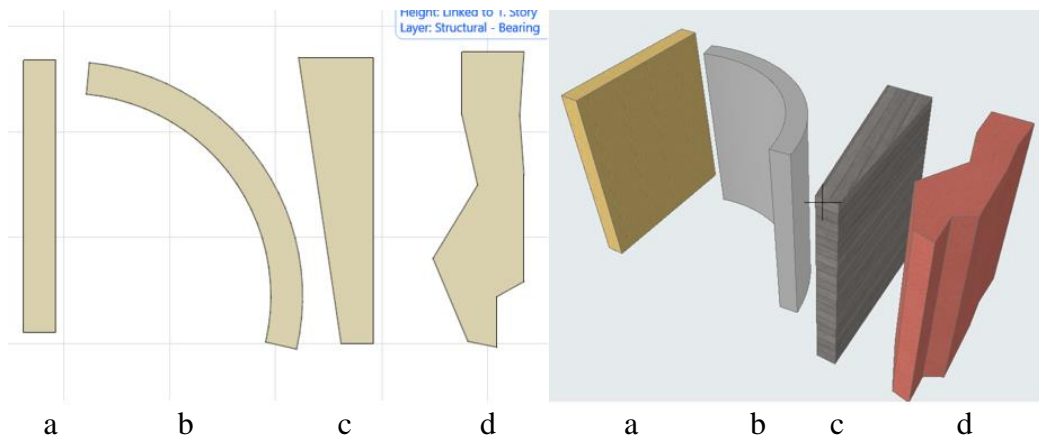
Figure 1.17 – Geometry methods of wall building:
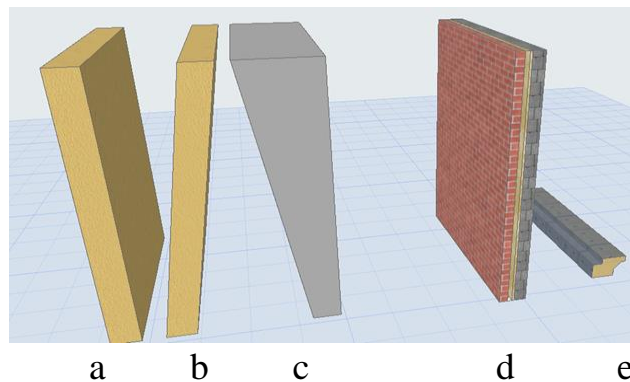a – straight; b – curved; c – trapezoidal; d – polygonal

Figure 1.18 – Types of wall profiles:
a – basic straight; b – basic slanted; c – basic double-slanted trapezoidal; d – straight composite; d – complex profile

It is also possible to determine the building material for the wall, in the window "representation on the plan and section" you can set the types of fills, colors, lines for the image of the element on the plan. In the "model" window, override surfaces of the wall and its adjustment options for the 3D-model (Fig. 1.19).
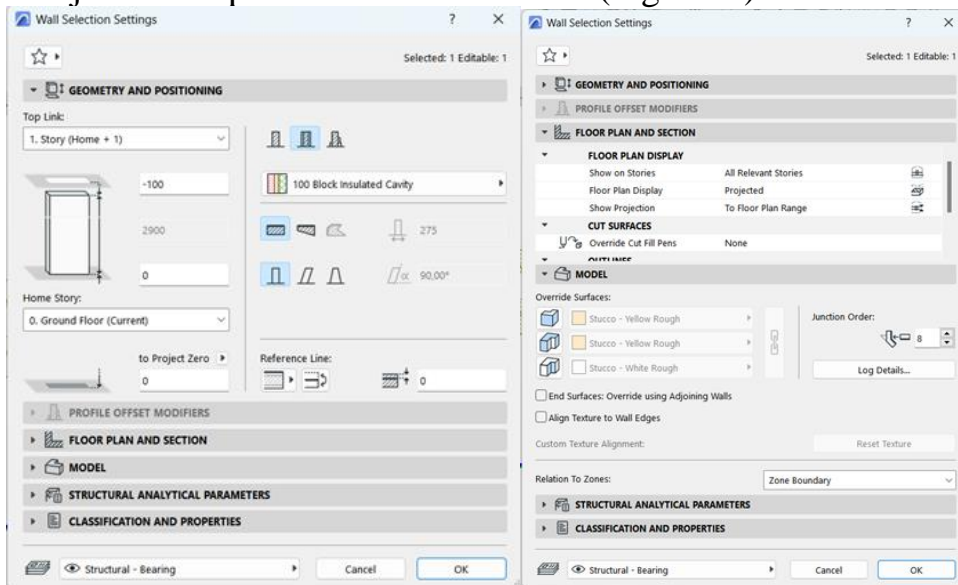

Figure 1.19 – The setting palette of the "Wall" tool

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There are 3 types of wall reference line (Fig. 1.20): outside face (1), inside face (3), center (2). In the case of a composite construction, in core center (5), core outside (4), core inside (6). When an object is selected, bold lines and dots appear on one side of the structure – this is the reference line.
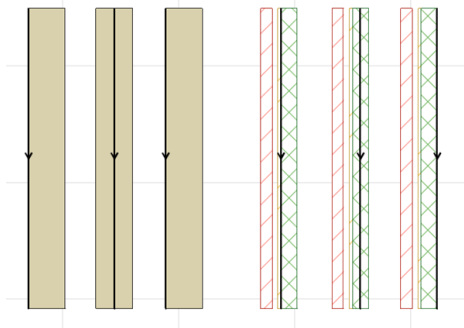

Figure 1.20 – Types of wall reference lines: a – for simple structures; b – for composite structures
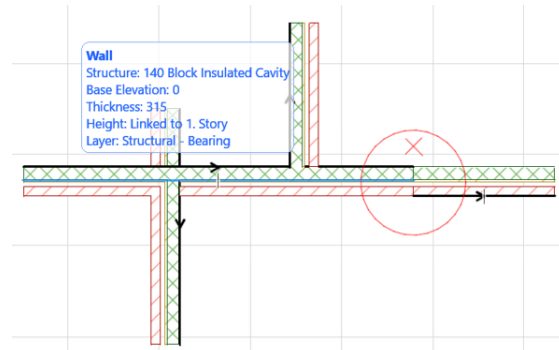
Figure 1.21 – An example of connecting walls

When the walls cross, the reference line of one wall is automatically extended to the reference line of the other, and the structural elements are connected into a single solid fill (Fig. 1.21). For proper operation, the reference lines of continuing elements or those with common corners must be on the same side. If the reference lines are different, the elements will not be connected visually (there will be a line between the fills) and it may have problems on 3D-view.

To check the reference lines, you can use tab *"View" – "One-Screen View Options" – "Walls and Beam Reference Lines".* After that, all reference lines of all elements are displayed on the plan in the form of arrows and can be adjusted.

To work with the wall in 3D-view, you need to switch to perspective (F3). To moving the focus around the model, you need to hold down the mouse wheel and move the cursor around the model, changing the image of the scene. You can zoom in and out by scrolling with the mouse wheel. The perspective of the model can be changed using the "orbit" tool in the 3D-visualization palette, or Shift + pressed mouse wheel.

In composite wall constructions, the thickness of the wall is always determined by its construction and is always fixed. *ArchiCAD* offers many composite construction options, according to the most frequent use, but if none of them are suitable, you can create your own composite construction.

If during design, the lines are very bold and interfere with work with the structural element (for example, not all layers of the structure are visible)

"View" – "One-Screen View Options" – "True line weight"

after that, all lines will be of the same weight, which is convenient when working with the project.

A **beam** is a horizontal structural element, which, although can have a certain angle, but cannot be placed vertically. A **column**, on the other hand, is a vertical load-bearing structural element that cannot lie in a horizontal plane. Columns and beams

have similar creation and editing methods. They can have different types of cut: rectangular (1) circle (2) complex (beam, I-beam, etc.) (3) multi-segment (4) (Fig. 1.22).
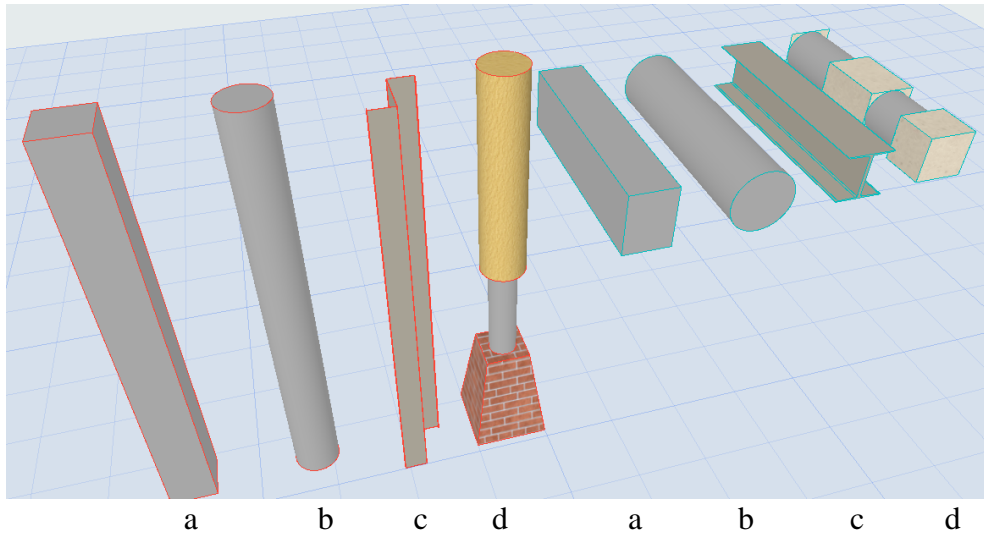

a   b   c   d   a   b   c   d

Figure 1.22 – Types of column and beam profiles:
a – rectangular; b – circle; c – complex; d – multi-segmented

A **slab** is a planar structural element, which can also consist of 1 material, or have a composed structure (for example, a concrete layer, plaster from below, insulation and floor covering from above), and also has reference lines in relation to the plane location: top, bottom, core top, core bottom. We can create slabs by points and dimensions, like a fill, or use auxiliary 2D-graphics for complex shapes. To do this, draw a closed shape with a spline or polyline. Select the contour, then activate the "slab" tool, hover over the contour, use the space bar to call the "magic wand" and click on the contour again. If we need to cut the same curvilinear or rounded shape from the overlap, we use the same method. We select the object, choose the "subtract from polygon" editing option, use the space bar to call the "magic wand" and click inside the contour of the hole (Fig. 1.23).

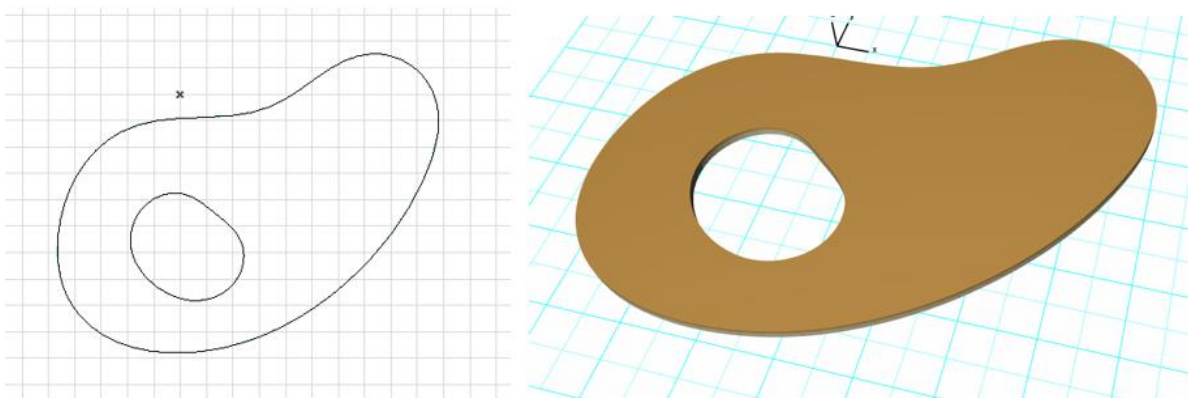

Figure 1.23 – An example of construction of a complex shape slab.

CONTENT MODULE 2 Two-dimensional modeling and the basis of 3D-modeling of objects of the urban environment

The practice of creating structural elements of a building

Grid system settings

The basis of the drawing of an architectural object is a grid system with axes. This is an information element that gives a clear understanding of the placement of the main structural (bearing) elements of the building and the dimensions between them. On the drawing, the grid is represented by dashed-dotted lines, which are located in the center of the supporting structure and are indicated by letters or numbers. Vertical axes are always marked with numbers, and their dimension lines are below the drawing. Horizontal axes are marked by letters and their dimension lines are on the left of the drawing (Fig. 2.1). On the drawing, dimension lines must be placed at a distance of at least 10 mm from the outermost element of the building. Sometimes a building can have a complex grid system with additional directions of axis lines (for example, a grid of columns that is rotated at an angle to the main axes). These axes are usually marked with one or two strokes (A', 2").
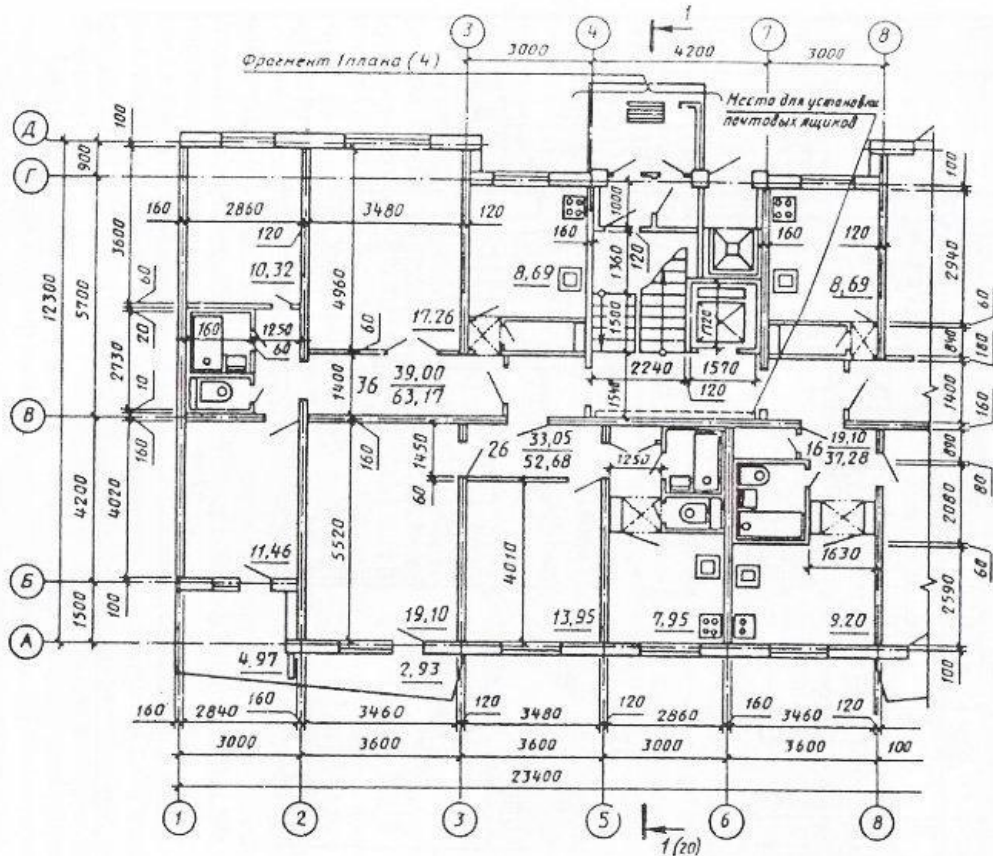

Figure 2.1 – An example of a grid system

To work with axes in *ArchiCAD* there is a special Grid element tool located in the Document section of the toolbar. This tool creates a single axis that is not anchored to the axis system in any way. It can be used when you need to add another axis grid to the existing grid system during the work. To create and configure the entire grid system, you need to open the tab *"Design" – "Grid System"*

This tool has a full range of grid settings in both 2D (on plans and elevations) and 3D. The main parameters are: geometry: orthogonal and radial, grid anchoring, naming rules for axes, distance between axes and much more (Fig. 2.2).
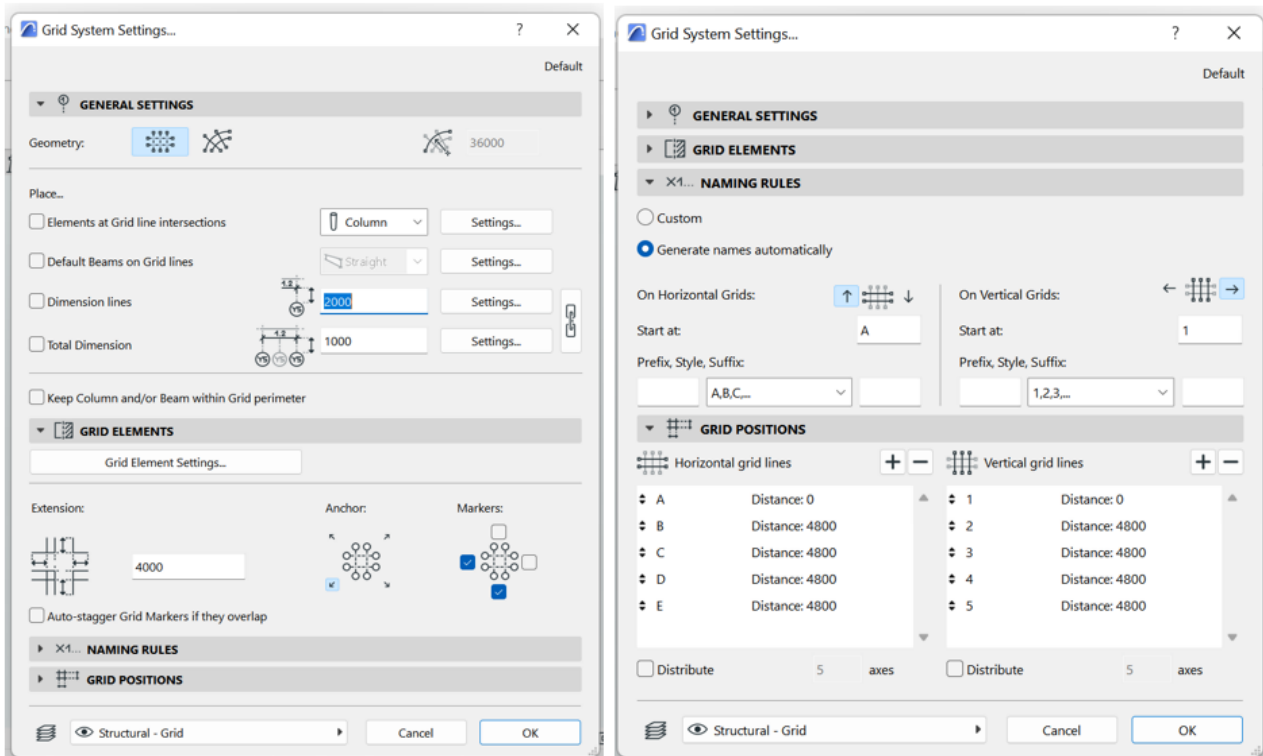

Figure 2.2 – A configuration of the grid system palette

Work on setting up the grid system also includes setting up dimension lines (dimension lines and total dimensions must be active). Before adjusting the dimension lines, you must activate a connection between these two elements by activating the lock next to them.

Story settings

ArchiCAD works with the design system on specific stories. All elements are located relative to the story, so they need to be configured at the initial design stage. If the height of the floor has changed during the design process, the program will automatically change the height of the structures, placement of stories, drawing of sections and elevations. The skipping between stories is carried out using the navigator.

To configure stories, use the tab *"Design" – "Story settings"*. In this tab, we can change the number of stories, names and their height (Fig. 2.3).
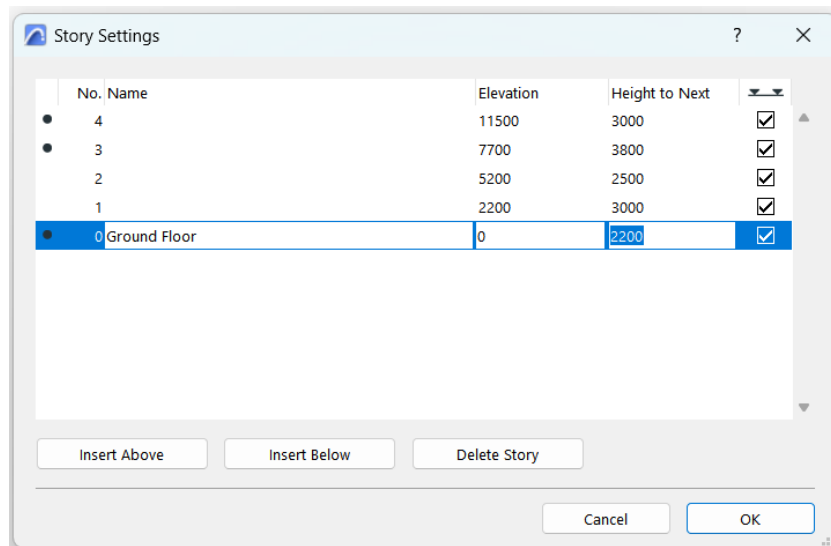
Figure 2.3 – Story settings palette

Work with images and drawings in ArchiCAD

Usually, designing on a computer is preceded by a stage of hand sketching. If the sketch needs to be loaded into the working area, use the "image" or "document" tool. After activating the desired tool, we can determine which specific file we will download, or simply drag it into the working area. "Image" – it is a static element that has a very narrow range of editing. In contrast, the "document" can change the frame of the image, cut off unnecessary parts.

After loading the sketch into the program, it is necessary to set its correct size - scale. For this we need to know at least one exact size. Any element except an object can be scaled. To do this, select it, go to the tab of the main palette *"Edit" – "Reshape" – "Resize"*.

We can determine the required scale with proportions or show it graphically. For sketches, the item "graphically" is suitable. After that, we return to the sketch, with two points we show the distance between the elements that we know exactly (for example, we know the width of the alley or some side), then we return to the first point and enter the exact distance to the second point with numbers.

Independent work on the topic
"The practice of creating structural elements of a building"

For completing an independent work, you have to build a constructive system of the cottage, which includes a grid system and load-bearing structures – walls and columns. To do this, follow the steps:

1. Place the image of the Ground floor plan and scale it according to the overall dimensions.

2. Determine the number of vertical and horizontal structural axes.

3. Specify the correct number of axes in the grid system settings.

4. Place the grid on the drawing.

5. Correctly move the plan drawing relative to the axes (the first horizontal and vertical axes should be located on the inside of their structural elements). This method of placing the axes is advisable to choose when the construction of the element (single-layer or composed) is unknown.

6. Adjust the placement of other axes relative to the supporting structures. To do this, it is necessary to temporarily ungroup (Suspend Group) the grid system and graphically move the axes to the desired place.

7. Check the accuracy of the dimensions. The dimensions between the structural elements must be multiples of 1 cm. Sometimes there is a problem when the dimensions between the axes are multiples of 1 cm, but the common axis is not. This is due to the rounding of units. In this case, you either need to adjust the common axis manually, which may affect future calculations. Or go to the tab: *"Settings" – "Project preferences" – "Calculation units and rules"*. Set the number of decimal places for "sizes" (select from the box above). After that, the decimal points will be displayed on the drawing, and then the axes can be made absolutely accurate.

8. Next place the drawing of the elevation of the building and scale it according to the dimensions. Determine the height of each story.

9. Create wall structures and slab according to existing axes. Copy them, if necessary, to other stories.

Practice of creating composites, materials and surfaces. Work with complex profiles

Using the correct constructions and materials is a very important point when creating a BIM model. Information about them can be automatically issued by the program in various catalogs, which simplifies the calculation of the volume of materials to be ordered, the speed of work execution, etc. However, the existing catalog of composites and materials is not enough, so in *ArchiCAD* there is an opportunity to create your own samples.

The creation of any element in *ArchiCAD* is located in a tab *"Options" – "Element attributes"*.

Here are the following functions: creation and editing of layers, lines, pens and colors, fills, surfaces, building material, composites structures, profiles, zones.

Learning the interface of the pallet for creating of composite structures

Composite constructions are inherent only to the following structural elements: wall, slab, roof, shell. Setting this item (in the lower right corner) is very important, because after creation, this construction will be displayed in the list of only those constructions for which it was created.

There are two options for creating a composite structure: to create a completely new one, or to make a copy of an existing composite structure and edit it. Usually, the name of the composite structure has information about the layers from which it is composed. It is also appropriate to indicate their thickness. For example: plaster 3, brick 250, insulation 100, cladding brick 65.

The composite structure consists of layers that can be added and removed. The key parameters of each layer are: the material from which it is composed, the type of construction (core, finish, other) and its thickness. You can also adjust the color of lines and fills on the plan. The layers should go one by one in a strict order (Fig. 2.4).
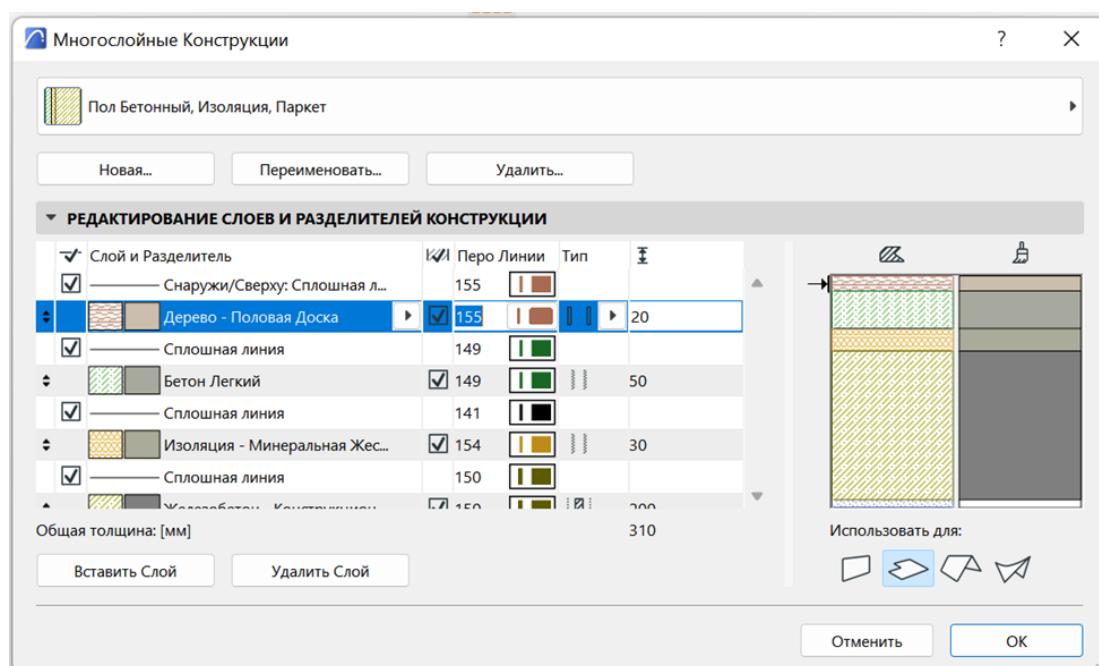

Figure 2.4 – The palette of the composite structure creator

The own materials creation

The building materials editing palette consists of two parts. On the left is a list of all existing materials where you can create a new custom material, on the right you can customize it according to its properties.

The key parameters for setting up materials are defining its fill, surface (as it will be displayed in 3D), and priority (Fig. 2.5). In addition, if necessary, other parameters and technical characteristics (thermal conductivity, density, etc.) can be specified in

the classification. The priority of materials determines their representation on the plan. So, if the plasterer determines a high priority, then it will even cut brick and concrete on the plan (Fig. 2.6).

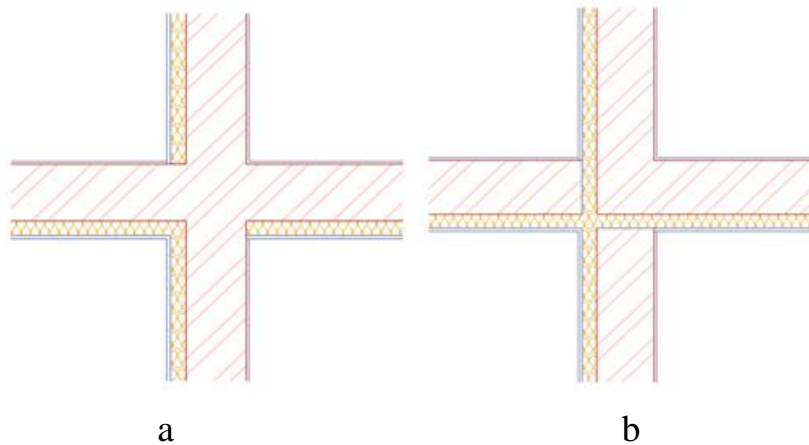a   b

Figure 2.6 – An example of the material priority: the highest priority has: a – brickwork has the highest priority; b – insulation
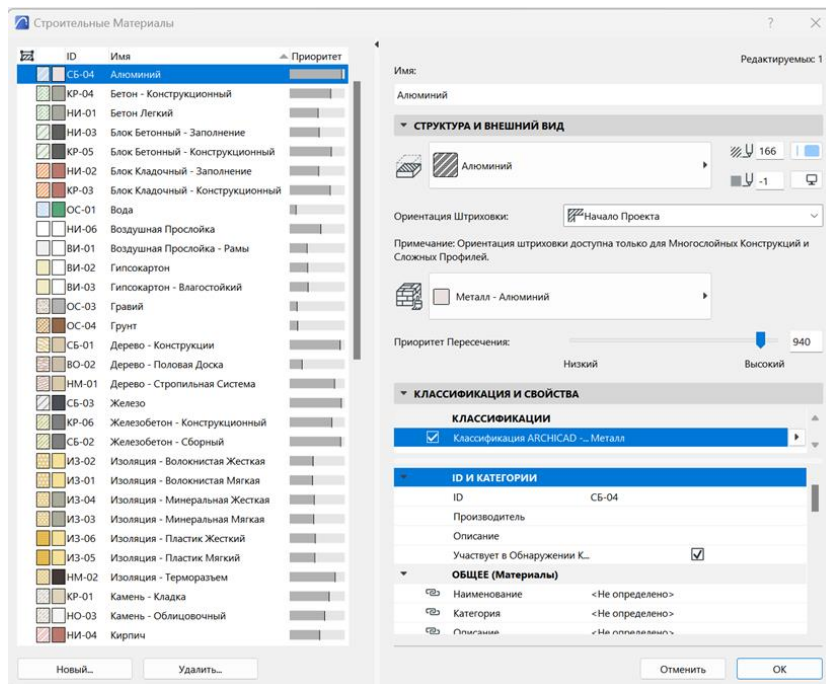
Figure 2.6 – The palette for creating and editing of materials

A new surface creation

Surfaces gives us the information about how the material will look in 3D and rendering. Depending on the type of surfaces, it can have different parameters: ambient, diffuse, shininess, reflection, etc.

We can create an absolutely new surface or on the basis of a copy of an existing surface. In most cases, it is advisable to use the copy, because it already has certain

settings. This option is used when the materials have similar characteristics (for example, pink glass can be created using blue glass as a basis).

Creating a new surface consists of loading an image of how this surface will look and setting its parameters (Fig. 2.7). It should be noted that the list of parameters will differ for different visualization mechanisms. If you have configured options for a Basic Engine and then want to use another one – *Maxon* – surfaces will not be displayed.

The surface image is loaded in the "texture" tab. In order to download another texture, click on the "find" button. You will then be taken to a list of the various textures contained in the *ArchiCAD*, but are not represented in the standard list. If you still haven't found the necessary texture, you can upload your own. The texture can be any image in jpg format. However, it is better to download textures from professional sites. The main characteristic of the texture is its seamlessness. That is, the pattern must be repeated and at the same time the seams are not visible during visualization. If the downloaded texture fits in shape, but has the wrong color, it can be corrected in any graphic editor. You can also set the texture size, rotation angle and duplication type. With the help of these parameters, you can create a correct realistic image. Thus, there should be about 15 rows of bricks in 1 m of building height, so the texture should be adjusted to this parameter.
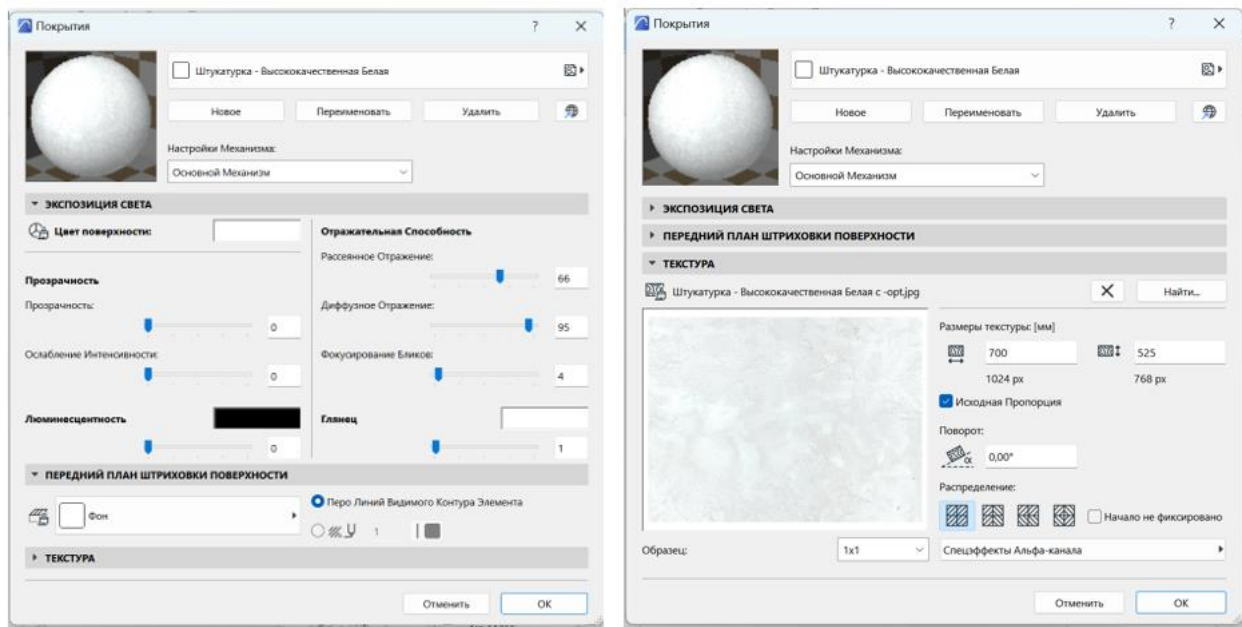

Figure 2.7 – The palette for creating and editing surfaces (textures)

Work with a profile manager

A profile is inherent in such tools as wall, column and beam. It helps to create a specific profile in the cut. With its help, you can create such elements as cornices,

plinths, specific columns (Doric) and other decorative elements. A profile is created in its editor (Fig. 2.8) *"Options" – "profile manager"*.

A creation of a complex profile is starting with a cross on the plan, as it is the reference line. If you draw a profile at a distance from it – in the plan it will also be created at a distance.

2D-graphic: lines, polylines, splines and feels are used for creating a profile. When you use some type of feel (metal, glass, stone) you set the material for the new profile and this material will be displayed in 3D. Changing the material for the profile in the future can only be done by returning to this tab and editing the fill. After saving a new profile, this profile will appear in the list of proposed profiled for the type of construction for which it was created. For example: if you have created a profile for a column, it will not appear in the list of beam profiles.
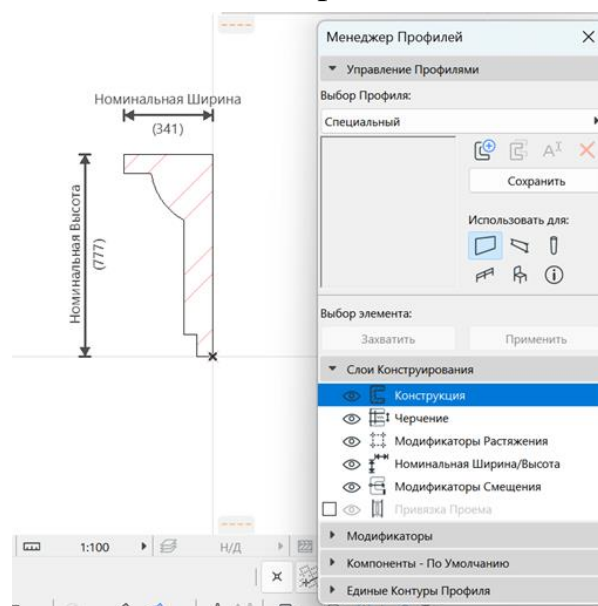

Figure 2.8 – An example of creating a profile

Independent work on the topic
"Practice of creating composites, materials and surfaces. Work with complex profiles"

For completing an independent work, you have to create new materials and surfaces for your cottage. To do this follow the steps:

1. Create a composite structure for the outer walls of the cottage.
2. Create your own material (for example, facing brick or plaster of a sample that is not presented in the standard set).
3. Create a surface for this material.
4. Try to create a profile for a cornice.

The practice of placing windows and doors in a building

General information about windows and doors

Windows and doors are elements that cannot exist separately from structural elements. They can be placed in walls, roofs and shells. To create an element, you need to choose an anchor (left, right, or center), specify the place in the wall where it needs to be located, specify the external side of the object (shown by a sun) and the side of the window opening. Depending on the design of the wall, the location of the window relative to the outer be may different. The size of a quarter of the window opening is responsible for this parameter. For a simple wall design, it can be along the outer edge or have a certain size. For a multi-layer structure, the quarter will be calculated relative to the load-bearing part of the structure. The setting of the reveal depth is important both from the point of view of the structure – protecting it from the rain, and for the visual effect, creating additional shadows and adding volume.

The *ArchiCad* Library has a large set of windows of various shapes, from standard to historical, showcases, etc. But each individual window can be customized in as much detail as possible, including the size, thickness and width of the frame, box, casement, lintels, handles, ebbs, slopes, etc. At the same time, in real projects, you need to pay attention to the parameters of doors and windows provided by manufacturers of such products, or take average indicators.

Element detailing on the plan can be customized depending on tasks, drawing, and scale. For this, we go to *"Document" – "Model view" – "Model view options"*.

In cases where the side part of the opening under the window or door has a surface that does not meet the requirements, but it can be adjusted in the window and door settings in the "opening and walls" parameters, you can set: as the ends of the walls (will correspond to the surfaces of the ends of the wall) or as a wall's surface.

Cladding the elevations using a morph

To create an elevation design, we use a rectangular morph. We draw the shape on the elevation drawing, but on the plan, it will be located exactly on the elevation line and it must be moved to the right place. If you need a morph of a complicated shape, we can create it with lines and create the morph using "magic wand". You can create a morph from several parts, and then use the ability to edit morphs "Boolean operation: union, subtract, intersect. For the morph, we set the surface as for the wall. The only difference is that it is not a constructive, but a hollow element, and also that we can individually adjust the surface for each facet. To do this, select the face on which we will set up the surface (hold down the Ctrl+Shift keys and select the face with the mouse) – *"Document" – "Creative Imaging" – "Aline 3D Texture"*. Next, choose an editing option: set the beginning of the texture (this function is suitable for working with images, for example, photo wallpapers) or set the direction of the texture. When the texture editing option is selected, a red square will appear on the morph or next to it, which is responsible for placing the texture. It can be moved by setting the

starting point, or rotated by setting the angle of the texture. At the same time, there is no need to edit the new surface, which is contained in the *ArchiCad* database. For a morph, you can set surface for each individual face.

Practice of creating stairs and ramps

The Stairs tool is located in the Design palette. Currently, it is a built-in interactive tool that is suitable for both architects and interior designers. It allows you to create the most detailed object by selecting and adjusting the desired type of construction and the appearance of not only the entire object, but also each individual step.

General settings of stairs

The general settings include: linking to stories, stair width, stair start and end, riser, height and depth of the goings (can be fixed or dynamically change during design), angle of placement of the riser, as well as placement of the baseline (Fig. 2.9).

a   b
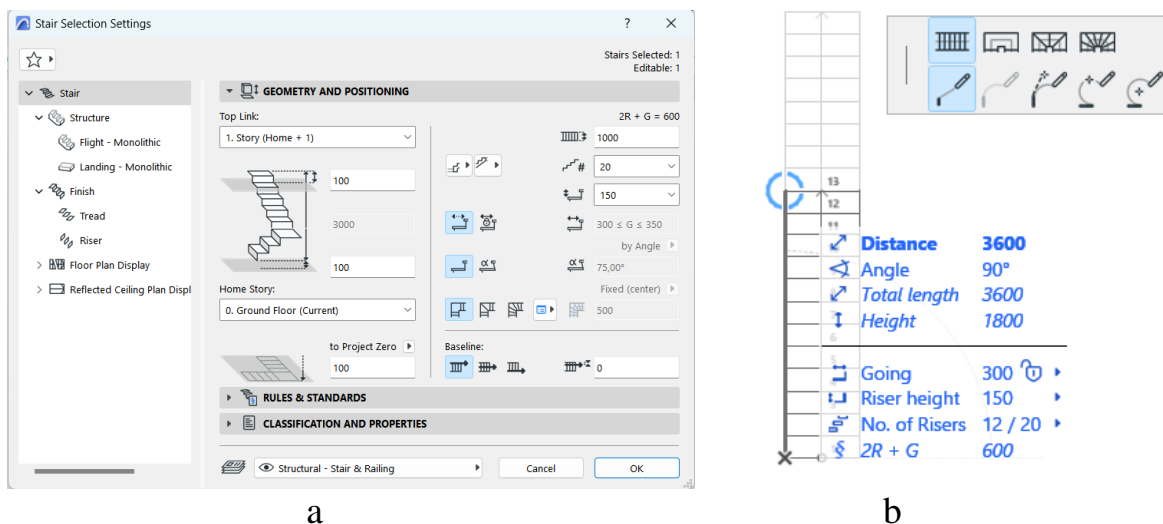
Figure 2.9 – The palette for stairs creating:
a – a palette for adjusting the stairs; b – a palette for the construction of stairs

The base line of the stairs is responsible for its configuration. Depending on the tasks, you can choose to place the baseline on the inner edge, on the outer edge, in the center and with a certain margin from the edges. The base line is the line that actually creates the stairs. When creating stairs, we need to specify the points of the staircase and the landing. On the palette of working with the tool in the upper row, you can choose the type of segment: flight, landing, winder with equal angels, winder with equal goings. You can switch between these types by pressing the "D" key. In the bottom row there are options for building the base line (configuration) of the stairs. With its help, we can create stairs of any shape: straight, spiral, mixed. You can switch between these construction options by pressing the "F" key.

After creating a stair, you can edit it. To edit the configuration, click on the baseline, which is highlighted in blue. As with other tools, we can inner a new nod (turn part of the march at a certain angle), round the flight (Fig. 2.10). By clicking on the start or end points of the stairs, we can redistribute the number of goings by increasing or decreasing the number of goings in the flight. In addition, we can change the segment type, for example, change the flight to a platform. To do this, you need to click on the baseline from the side where the segment will be changed, select the "select segment type" function in the editing palette and replace it. When editing the baseline, the steps will always rotate perpendicular to it.
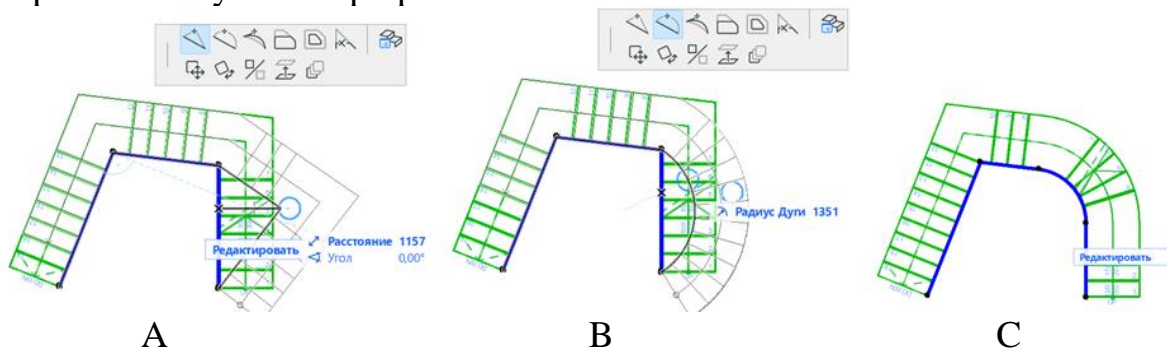

| A | B | C |

Figure 2.10 – The editing the configuration of stairs:
a – creating and moving a new nod on the baseline; b – rounding of the baseline; c – rounding of the corner of the baseline

In order to change the shape of the stairs, you need to click on the outline of the stairs (Fig. 2.11). On the side of the baseline, the outline and the baseline coincide, you can switch between them using the Tab key.
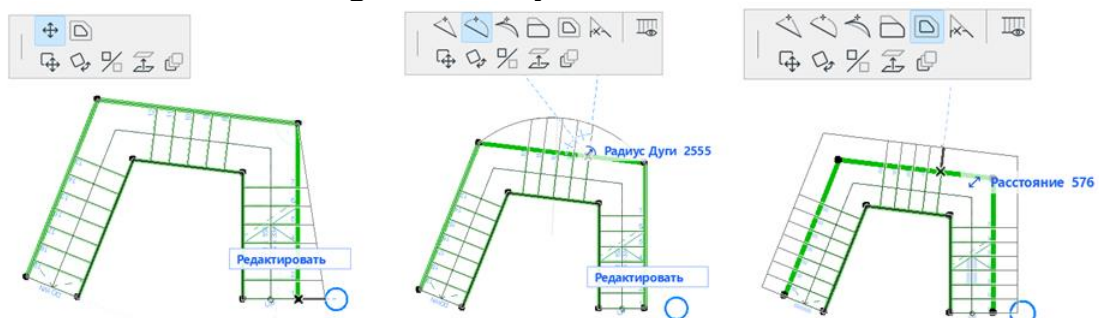

Figure 2.11 – The editing the form of stairs:
a – creating and moving a new nod; b – rounding of the flight; c – increasing the width of the stairs

Setting up the constructure and finishing the stairs

There are 4 types of construction for stairs: monolithic, beam, cantilever, stringers only (Fig. 2.12). *ArchiCAD* allows you to choose different types of construction for the flight and the landing. Each constructure has many settings: thickness, structure material, coating, joints, etc. In addition, each type of construction has subtypes. For example, a beam can be straight or stepped. You can also not show

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the structure in 3D by deactivating it. This also applies to finishing. From the finishing, you can separately adjust the goings and the risers, their shape, surface, accessories etc.

Interactive editing of stairs

However, in addition to setting all stairs, you can edit individual goings and risers. To do this, select the stairs and click the "Edit" button. Editing can take place in 2D- and 3D-view. When going to the editing palette, we can use the Shift key to select editing elements, for example, 3 goings from the flight and give them a different surface or, for example, add rubber pads to prevent slipping. You can edit the shape of the going by clicking on its contours. For the convenience of editing, you can unlock the external environment. It is advisable to adjust the 3D-image of the stairs when displaying them "schematically", and to adjust the symbol on the plan in the form of a "symbol". There you can change the orientation of the numbering of the steps, the arrow of the rise, the placement of the section of the stairs, etc.
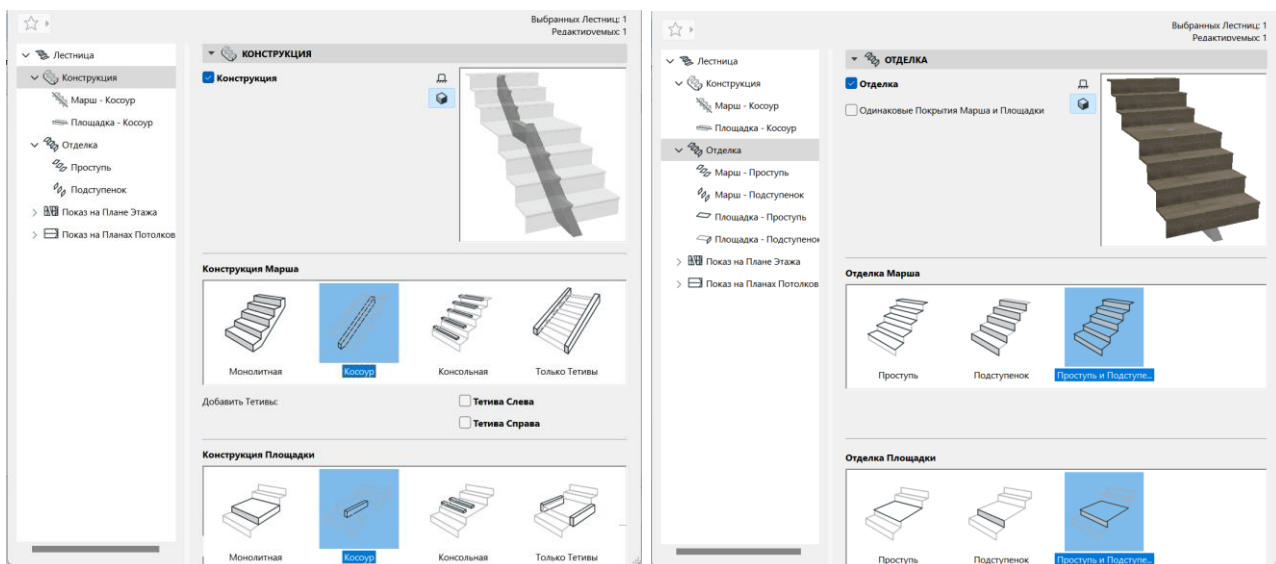

Figure 2.12 – The palette for adjusting the design and finishing of the stairs

The practice of roof creating

Construction of the roof

A roof is a structural element that can be single-plane or multi-plane. According to the construction method, the roof can be: complex, rectangular, rotated rectangular. By structure, the roof can be basic or composite.

In the roof settings, you can define: anchoring level, roof pitch, angle of roof endings, eaves overhang and roof levels if different parts have different pitches.

To build a single-plane roof you have to determine the reference line, the side of the plane relative to the reference line, and the contour of the roof. If you create a roof consist from two single-plane roofs and you need to connect them correctly, you need

to select one roof in 3D, hold down the Ctrl key and press on the opposite roof, repeat the action for another roof.

A multi-plane roof is built along the contour points of the building and can have 4 or more slopes, which are created automatically depending on the shape of the building (Fig. 36).
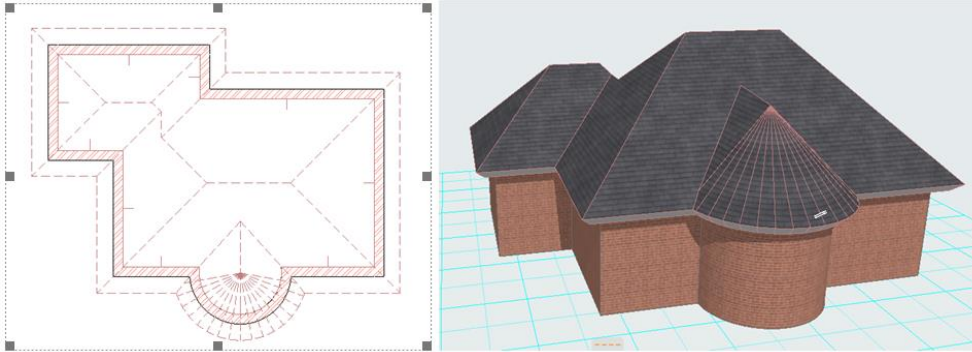

Figure 2.13 – An example of a multi-plane roof

You should pay attention to the "add to polygon" function: if for a single-plane roof it only changes the length of the roof element, then for a multi-plane roof it is possible to add a new roof element, such as a dormer window. To do this, you need to click not on the edge of the roof, but on the reference line and select this function. After determine the contour of the addition element.

Trim elements to roof

There are three options for trimming elements by the roof:

1.   Using the "trim under the roof or shell" command. Select the walls and roof, press the "trim" command. If the elements are cut incorrectly (holes appear in the corners, etc.), you need to change the roof settings: *"Settings"– "model" – trimming body "contours down".*

If, after trimming, the outlines of the walls are visible through the roof, the priority for the wall material should be reduced.

2.   "Trim under a single-plane roof"– this method allows you to trim not only walls and columns, but also the other roofs, windows, doors. If the roof was initially created as a multi-plane roof, you need to select it, click the right mouse button and select "crop to single-plane roofs". Next, select the trimming element - the tab *"Design" – "roof extras" – "crop zone" – determine the necessary settings – complete the trimming.*

The disadvantage of this method is that when the roof is moved up, the height of the wall remains at the trimming level, some parts may be trim incorrectly. If the

method is not suitable, select all the cut walls – *"Design"* – *"roof extras"* – *"undo all crops"*.

3.   *"Solid element operations"* – this method is suitable for trimming any elements. It is located in the tab *"Design"* – *"solid element operations"*. To make trimming, you need to select the operator (the element that will trim the object) and the elements, as well as the type of subtraction.

Content module 2
"Two-dimensional modeling and the basis of 3D-modeling of objects of the urban environment"
Develop plans drawings of the cottage and save them in pdf on format A3.

CONTENT MODULE 3 Two-dimensional modeling of master plans and 3D-design of landscape objects

Study of the master plan elements.
The practice of creating a relief

Master plan is a 2D-drawing that depicts the placement of all buildings and design elements at ground level. It is presented in lines and fills. The building is shown as the outline of the exterior walls of the 1st story, depicted as a bold black line with white fill inside, with no depiction of the building's interior. All entrances to the building are shown by a perpendicular line on this contour. Their image is necessary for designing a network of paths and zones around the building. For light constructions such as pergolas, canopies, etc., only a section of the columns is shown on the plan, and the rest of the space is shown as something we can walk through. For a more understandable presentation of the master plan, you can use different types of fills, displaying different materials and surfaces. Also, the master plan shows the explanation of buildings and zones (for example, the barbecue area) and conventional designations (an example of the master plan is given in the Appendix).

Slabs and 3D-mesh can be used for creating a cottage site. The slab can be used only if the site does not have a slope. The 3D-mesh is the best tool for working with relief. This tool makes it possible to determine the height of each given point, or horizontal. It will be studied in detail in the 4th semester.

A practice of work with drawings of plans, elevations, sections

After completing the work on creating a 3D-model and development of each plan, it is necessary to proceed to the stage of creating drawings based on them. There are different types of plans:

1) structural plan – depicts the floor structures, the grid of the axes of the load-bearing structures and the dimensional lines between them, the explanation of the premises, floor height;

2) measurement plan – depicts the dimensions of all structures, windows and details;

3) marking plan – depicts window and door markers, their ID numbers, sizes;

4) reconstruction plan – depicts the elements being dismantled and created;

5) furniture plan, roof plan, roof structures, etc.

Thus, we see that from one correct done 3D-model we can create many drawings different from each other. You can adjust the drawing by activating the necessary layers. After adjustment, you need to save the final image in the view map.

View is a page that stores all information about the settings of the plan and other drawings at the time of its saving (layers, scale, detailing, graphic placement). To save it, you need to go to the view map and click "save view", and name it. Thus, the view map stores a list of all the views for printing, after which they are transferred to the layout. However, working with drawings in the working space or in the view map, will affect the 3D-shape. If the plan drawing has certain defects, such as incorrectly connected fills, extra lines, etc., but it is not desirable to change anything in the model, you can use the "worksheet" tool. To do this, you need to activate the tool and highlight the measures with a frame. After that, it will be generated a drawing, created only with lines and fills, which can be adjusted like normal 2D-elements. This 2D-drawing is self-contained and does not affect changes in the 3D-model. It is advisable to adjust the plan using the worksheet at the very last stage after completing all the settings. After finalizing the plan in the worksheet, it must also be saved in the view map.

There is a similar tool **detail**. This tool allows you to create a drawing of a certain part of the plan, elevation, section and show it on a different scale, displaying the dimensions and construction in detail. A detail can be a projection of a certain part of the plan, be linked to another drawing, or not be linked. For an unrelated part, you can upload any drawing (for example, a drawing from another project or downloaded from the Internet).

Drawings of elevations, sections and sweeps of interiors are similar in their essence and settings. Like all drawing tools, there are settings, but the settings palette is not automatically displayed, as with other tools. To configure, you need to find the

required drawing in the navigator (for example, "section 1 - 1" or "north elevation"), click on with right mouse button and select "section/elevation settings".

Important parameters are:

1. Status: you can choose an "auto-rebuild model", "manual-rebuild model", and "drawing". The first two are interdependent with the 3D-model. If you change the mark of the overlap by moving it on the section in the 3D-model, it will be also moved. The "drawing" status creates a separate drawing from 2D-elements, similar to a "worksheet". After defining the status of the section as "drawing", it can be edited. But after editing, returning to the "auto-rebuild model" status, the changes will not be saved. Therefore, it is necessary to save the drawing in the view map.

2. Horizontal range: zero depth, limited (must be indicated on the plan) or infinite.

3. Vertical Range – only certain floors can be selected.

4. Display of visible elements and elements in section:

– nothing – non colors;

– surface color feel – all coatings are displayed in a single-tone fill, the color of which is specified for each material in the material settings;

– surface texture fill – fill in the form of brick, wood, etc., which is specified in the material settings, is added to the color of the material;

– shading is also available for all these variants, which is displayed on the rounded elements of the model;

– creating shadows on the elevations and sections is also available.

It should be noted that the section is a technical drawing, for which a white model is used and only structural elements in the section are depicted with fills according to the material and construction of the element.

Setting up a 3D-image for rendering

Setting up a 3D-image for rendering

The standard rendering process includes modeling the scene, setting up of materials, lighting and cameras, texturing and creating a final photorealistic image (rendering). Let's determine how you can use Cine Render to edit these elements of the scene and create a realistic picture. Image rendering settings are located: *"Documents" – "Creative imaging" "PhotoRendering settings"* or in the *"3D visualization"* toolbar.

In the "Scene" *ArchiCAD* offers to choose a template rendering configuration for different conditions. Choose a design option, for example, "Exterior lighting, daytime, medium". In the Engine, select Cineware Render by Maxon. Set the quality of shadows

and rendering in general using the appropriate palette. The higher quality, the slower the image rendering will be. In the "Light sources" section, the brightness of the lighting is adjusted. Leave the settings at their defaults.

The "Environment" option allows you to adjust the sky in the image. Choose "Physical sky" if you want to adjust the sky in the program more correctly, or "HDRI sky" if you want to use a high dynamic range card for more realism. Such a map is loaded into the program separately. Activate "Use ArchiCad Sun Position", if you want to set the position of the sun in a certain area, time and date.

Next, set the size of the final image in pixels by going to the corresponding icon. Lock the dimensions to preserve the proportions of the frame. At the highest quality of 300dpi, you can use a small image size. The window at the top of the rendering palette is for doing a quick pre-render. Click on the circular arrows and within a short time you will see a thumbnail of the rendering.

For more detailed visualization settings, you need to activate "Detailed settings". These include setting the light adjustment, shadow casting, global lighting parameters, color effects and other parameters. Leave most of these settings at their defaults. But some of them might be useful more often:

– in the "Environment" section "Physical sky" you can add and adjust such effects for the sky as sun, fog, rainbow, atmosphere and others;

– in the "Options" section, you can realistically work out the "Grass" and greenery in the image to a living and natural state. Note that grass miscalculation also increases rendering time.

To adjust materials when working with the creation of new surfaces, you should work specifically with the settings for "Cineware Render by Maxon". The settings of the materials, in general, should also be left at default, except for a few:

– if necessary, change the color of the material or give it a texture on the "Color" tab. For realistic visualizations, it is advisable to always use textures. By default, in *ArchiCAD* many materials have textures.

– give relief to the material. In the corresponding channel, place a texture that will create naturalistic irregularities in the material.

– when working with materials, adjust the transparency, glossiness and reflective ability of materials;

– with custom "grass" you can also make a texture for shaggy surfaces, carpets, fur, etc.

After configuring the materials, press *"Start visualization",* or use the F6 hotkey. The calculation mechanism will start. You just have to wait for it to end. To finish saving the image, you need to right-click on the image and select "Save As", specify a place on the disk for saving, or place the image on the layout. PDF format should be used only for saving drawings, jpg is also suitable for images.

To save the album, it is necessary to complete the design of all drawings on the layouts. If necessary, you must first create a suitable set of basic layouts with stamps and fill them, and delete the others. Next, you need to create a set of layouts that should be placed one after the other in the order in which they will be saved in the album. It is advisable to create a folder and move all layouts there. In order to save the entire album as one pdf file, you need to use the publishing set (the tab that comes after the set of layouts in the top row of the navigator). In order for it to be convenient to copy sheets from the layouts to the publishing set, you should use the organizer. To do this, select "show organizer" in the drop-down tab in the mini navigator.

In the left part of the organizer, you need to select the layouts book, in the right – the publishing set, and move (copy) the folder of layouts from the left part to the right. In the right part, you should select this folder and then you can work with the settings of the files that will be saved: define the format of the document, combine into one document (album), define other parameters (adjust the color of the images, the thickness of the lines), in the additional parameters you can configure the export layers in pdf. This is a function in which not a single image is exported to PDF, but all layers separately and they can be turned off showing what is needed.

In order to choose the place where the album will be saved, you need to complete the settings. To do this, click on the folder with the right mouse button and select "Properties of the publishing set", select the following parameters: publication method – save in files; create a single file, specify the name and path of the file, select the pdf format again. We complete the settings and press the "Publish" key. Next, the file will be saved step by step to the specified location. It takes about 1 minute.

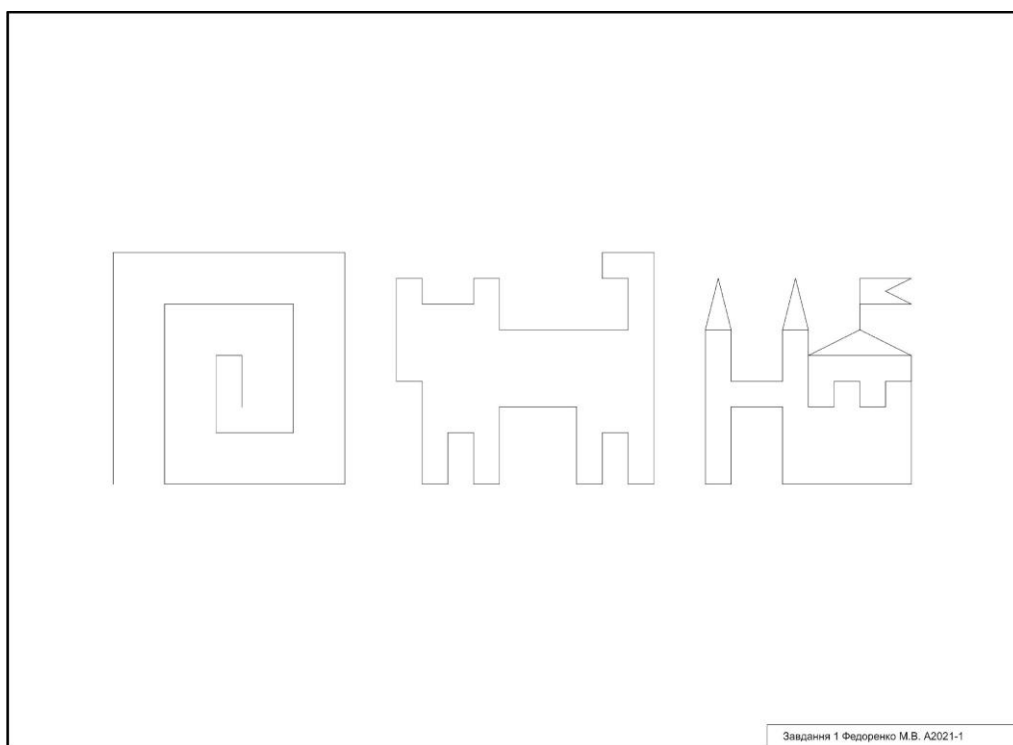### Independent work for content module 3
"Two-dimensional modeling of master plans and 3D-design of landscape objects"

Develop the drawings of the master plan of the site, section and elevations of the building, visualization of the building and save them on format A3.

LIST OF RECOMMENDED SOURCES

1. ArchiCAD 25 Reference [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: 29.09.2022). – Title from the screen.

2. 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.

3. Sulbaran T. Introduction to ArchiCAD: A BIM Application : tutorial / Tulio Sulbaran, Mohd Shiratuddin, Shane Germany. – Edition 1. – New York (USA) : Delmar Cengage Learning, 2010. – 528 p.

4. Atkinson D. LightWorks in ArchiCAD: The Things You Need to Know : tutorial / Dwight Atkinson. – London (England) : Beginner-No-More Publishing, 2005. – 208 p.

5. ArchiCAD for AutoCAD Users Paperback : tutorial / Scott MacKenzie, Simon Gilbert, Geoffrey Moore Langdon [and other]. – Budapest (Hungary) : GRAPHISOFT R&D, 2008. – 76 p.

6. Nicolson-Cole D. Object Making with ArchiCAD: GDL for Beginners : tutorial / Devid Nicolson-Cole. – Budapest (Hungary) : GRAPHISOFT R&D, 2000. – 110 p.

7. MacKenzie H. ArchiCAD 19 – The Definitive Guide : tutorial / Scott H. MacKenzie, Adam Rendek. – Birmingham (England) : Packt Publishing, 2010. – 295 p.

8. Visualization in Archicad [Electronic resource] : site. – Electronic data – Updated constantly. – Access mode : https://uk.soringpcrepair.com/visualization-in-archicad/, free (date of application: 05.10.2022). – Title from the screen.

9. BIM objects [Electronic resource]. – Access mode: https://www.bimobject.com/ua, free (application date: 18.11.2022). – Title from the screen.

10. Organization of the workspace and the formation of a project template in ArchiCad [Electronic resource] : site. – Electronic data – Updated constantly. – Access mode : https://graphisoft.com.ua/otkryvaja-zanovo-organizacija-rabochego-prostranstva-i-formirovanie-shablona-fajla-proekta-v-archicad/, free (application date: 27.11.2021). – Title from the screen.

Завдання 1 Федоренко М.В. А2021-1

Figure A.1 – Independent work on the topic
"Work with "Grids and Background". Absolute and relative coordinates"
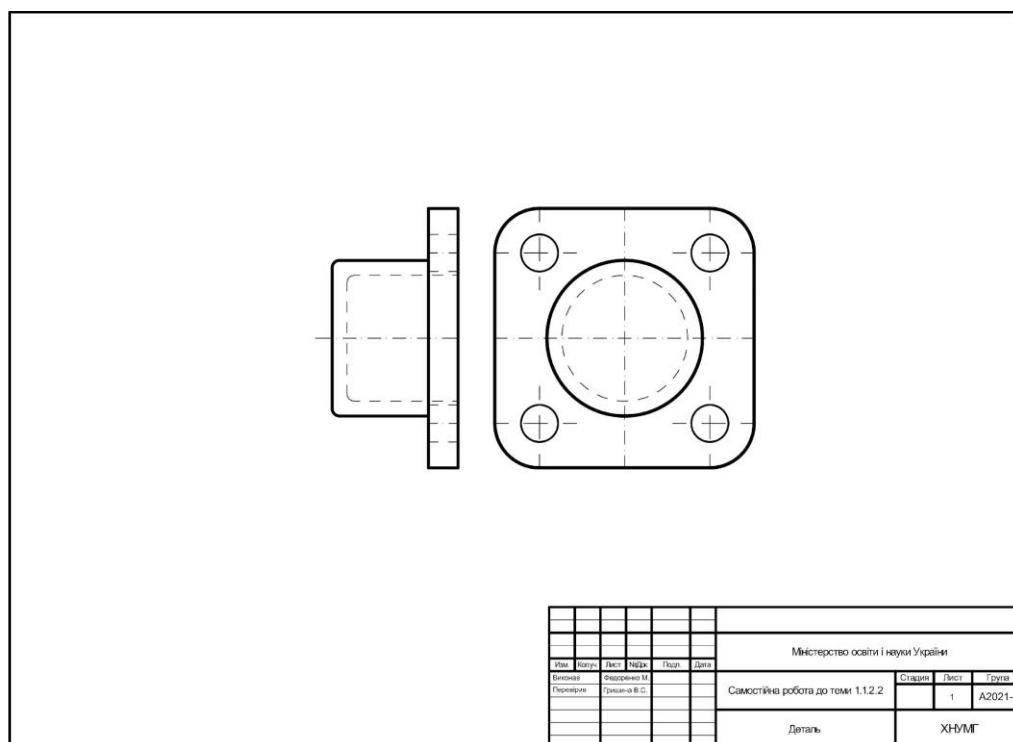
Figure A.2 – Independent work on the topic
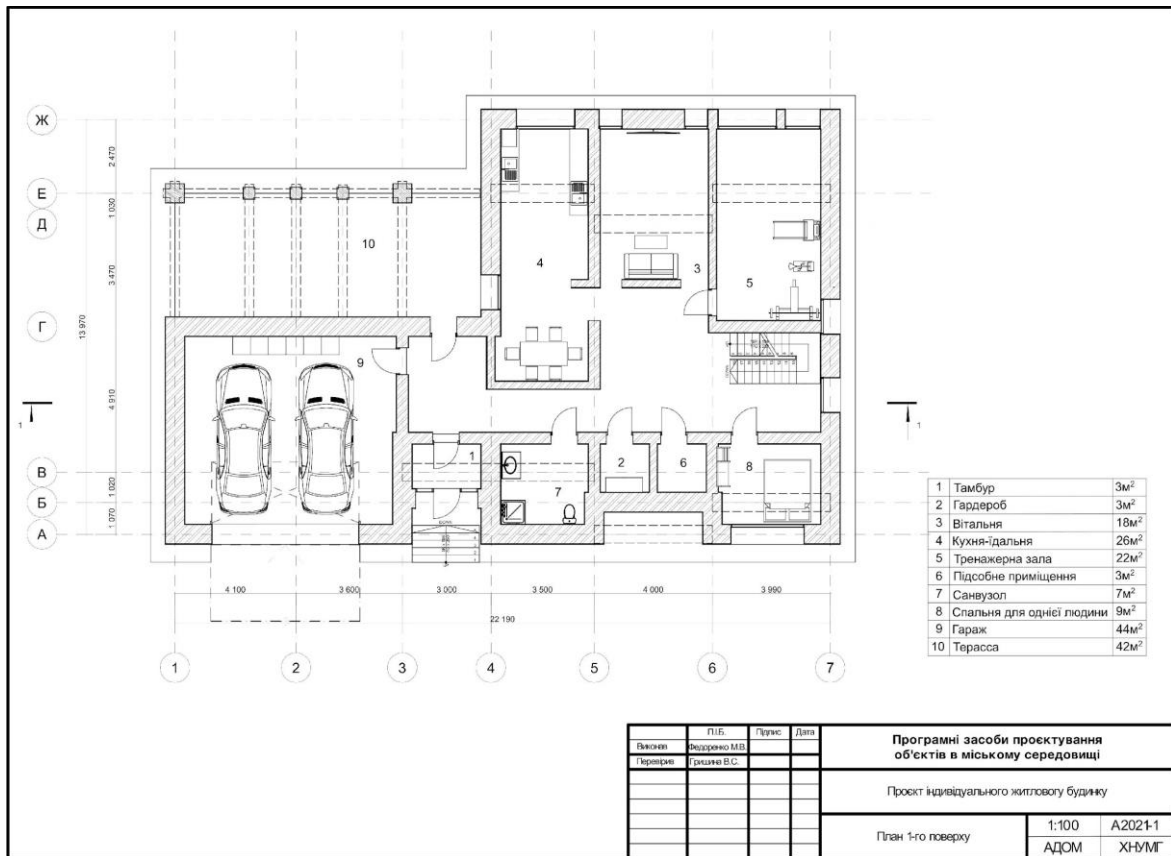*"Practice of creating and editing 2D-primitives. Guide lines. Practice of creating a detail drawing"*

Figure A.3 – Independent work on the topic
"Principles of "replication" editing.
The practice of building a plan of the assembly hall"

Figure A.4 – Independent work to the 2nd content module
"Example of design drawing of the Master Plan of the site"

Figure A.5 – The example of building plan drawing
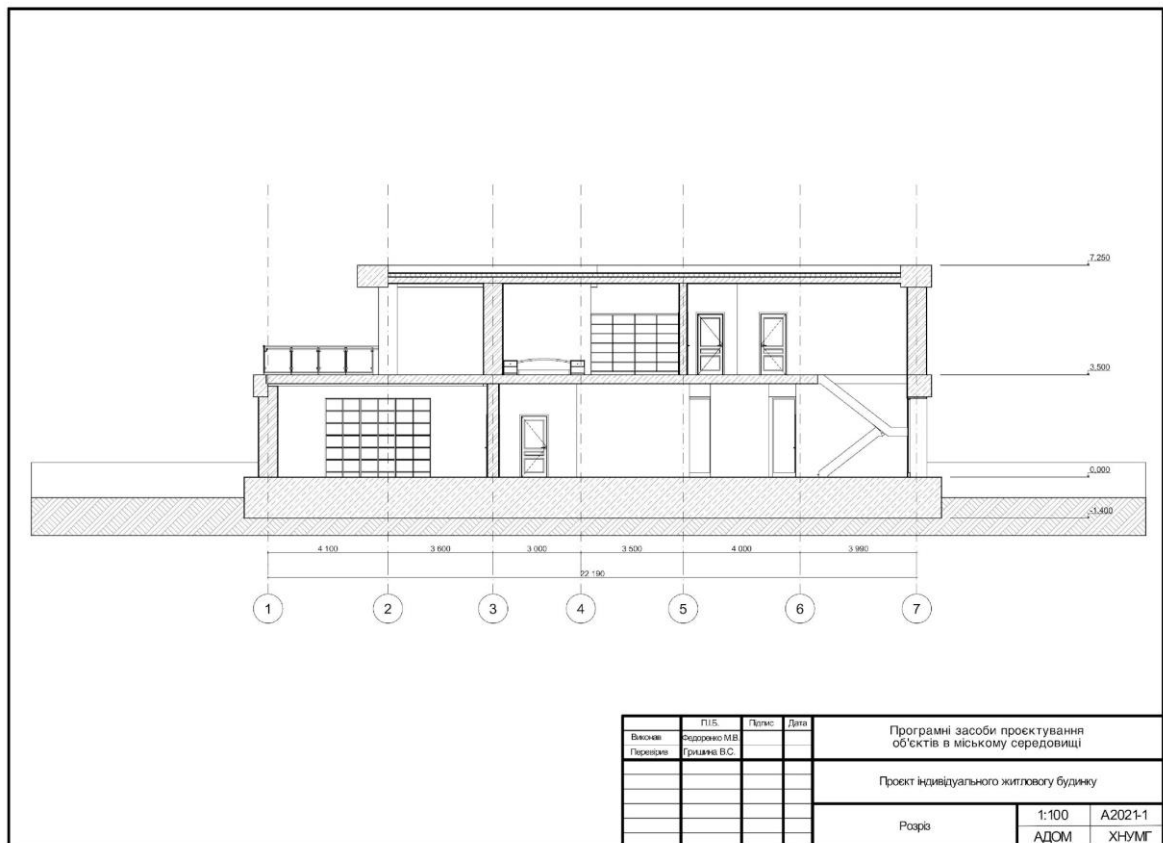
Figure A.6 – The example of a section drawing

Figure A.7 *– The example of an elevation drawing*

Додаток 1 (візуалізації)

Figure A.8 *– The example of visualization of the building*