

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

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Methodological Guidelines

for practical and independent work
on the discipline

**“ARCHITECTURAL DESIGN:
GROUND GARAGE FOR CARS FOR 150 PARKING PLACES”**

*(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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INTRODUCTION







The number of vehicles on the roads of large cities of the country is growing every year. It is not enough to have conditions for maintenance and traffic management to fully, comfortably and safely use a car. It is also necessary to observe the conditions for temporary and permanent storage.

Free parking area is permanently located in deficit. Therefore, to solve this problem, it is necessary to build multi-storey garages. A multi-storey garage is a specialized building that allows you to place a large number of cars in a small area.

When parking a car on the ground, the area for one place storage is 25 sq. m (with driveways), on two levels – 15 sq. m, in three – 10 sq. m, in four – 8 sq. m, in eight – 4–5 sq. Therefore, in the context of a constant increase in the number of cars and a lack of free space in the dense development of large cities, the most rational is the construction of multi-storey parking garages.

In the city center it is necessary to provide only temporary parking and multi-storey garages.

Advantages of multi-storey garages:

-  small area of the territory;
-  availability of communications;
-  use of prefabricated structures;
-  operational maneuverability;
-  high reliability of storage from damage and theft;
-  clearing the territory from parked cars.

The methodological guidelines provide the material necessary for the implementation of practical tasks and tasks for independent work of students in the study of the discipline “Architectural design: Ground garage for cars for 150 parking places”.

The purpose of these guidelines is to acquaint students with the design features of ground garages. In the methodological recommendations theoretical information on the design of multi-storey parking lots for cars are considered, and regulatory data on design are given. The features of the formation of the planning structure of a multi-storey garage and the surrounding territory are described. The fundamentals of constructive solutions for ground garages using the modern materials are given.

These guidelines are intended for 2-nd year students of specialty 191 – Architecture and Urban Planning.

1 GENERAL INFORMATION. REGULATORY REQUIREMENT FOR THE DESIGN OF GROUND GARAGES

Multi-storey garages are highly specialized structures designed to accommodate as many cars as possible in a minimum volume. For this purpose, floors for storage of cars, entry and exit ramps, dispensers, fuel tanks and maintenance workshops are used. Each of these elements has its own purpose, certain dimensions and affects the appearance of the entire structure. As with any structure, a unity of form and content must be achieved in a garage building.

When shaping the appearance of the city, the architect must understand that the garage should be more than a properly designed building. Only in this case can he fulfill his purpose.

The garage must be built within walking distance from the places of permanent residence of car owners. Therefore, it is rational to organize permanent storage of cars in a large residential area. Garages for temporary parking are most often built in public places, for example, near shopping and business centers.

City public garages will be able to fully fulfill their purpose of unloading a business center or any other shopping area only if round-the-clock car storage is limited, and most places are intended for short-term parking or parking for several hours.

Volume spatial characteristics of the garage, as a kind of transport structure, can actively influence the urban environment, the silhouette of the city. Therefore, when designing ground garages in the existing dense urban development, it is necessary to take into account its harmonious implementation into the area of the district.

The volumetric and imaginative solution of garages should be combined with the architecture of administrative and shopping centers, residential complexes, entertainment facilities, transport and communication hubs, and be organically integrated into the transport infrastructure of the place.

A multi-storey garage project should not contain only parking spaces, ramps, elevators and other necessary mechanisms for moving cars. The garage must have a daily maintenance room that has a convenient connection to the parking lot, and a maintenance sector. Support areas should be located near the maintenance area. Service premises should be designed so that they can simultaneously have access to the parking area and the car pick-up and drop-off sector.

The design of garages must be done taking into account the norms of Ukraine. The rules set out the basic norms and requirements for volume-planning decisions, as well as for the engineering equipment of parking lots and garages.

TERMS AND DEFINITIONS

Permanent storage of cars – long-term round-the-clock storage of vehicles in parking lots and garages in permanently assigned to specific car owners parking spaces.

Temporary storage of cars – storage of vehicles for various purposes of periodic or occasional visits to parking lots and garages in places not assigned to specific car owners.

Parking – a specially equipped outdoor area for permanent or temporary storage of cars

A garage – a building (structure), part of a building (structures) or a complex of buildings (structures) with premises for permanent or temporary storage, as well as elements of maintenance of cars and other motor vehicles.

Ground garages – building, structures, floor markings of the main premises which are not below the level of the planned surface of the earth.

Ground garage of open type – in which not less than 50 % of the area of external protections on each tier (floor) make openings, the rest – parapets.

Mechanized garages – houses, buildings with transportation of cars to storage places without starting the engine with the use of special lifts and mechanisms of various systems (without the participation of drivers).

Manege-type garages – buildings, structures in which cars are placed in a common hall with access to a common internal passage.

Box-type garages – buildings, structures in which cars are stored in separate boxes, leaving which is carried out directly outside or on the inner driveway.

Manege-box-type garages – buildings, structures in which separate places for storage of cars are isolated from the general passage by enclosing partitions or grids.

A ramp is an inclined structure designed to enter (exit) cars at different levels of the garage.

A parking slot (in the parking lot or in the garage) is the area required to accommodate one car, consisting of the horizontal projection area of a stationary machine with the addition of additional distances (protective zones) to adjacent vehicles or any obstacles.

THE MAIN TYPES OF GARAGES

The main types of multi-storey car parkings are presented the scheme in Figure 1.1

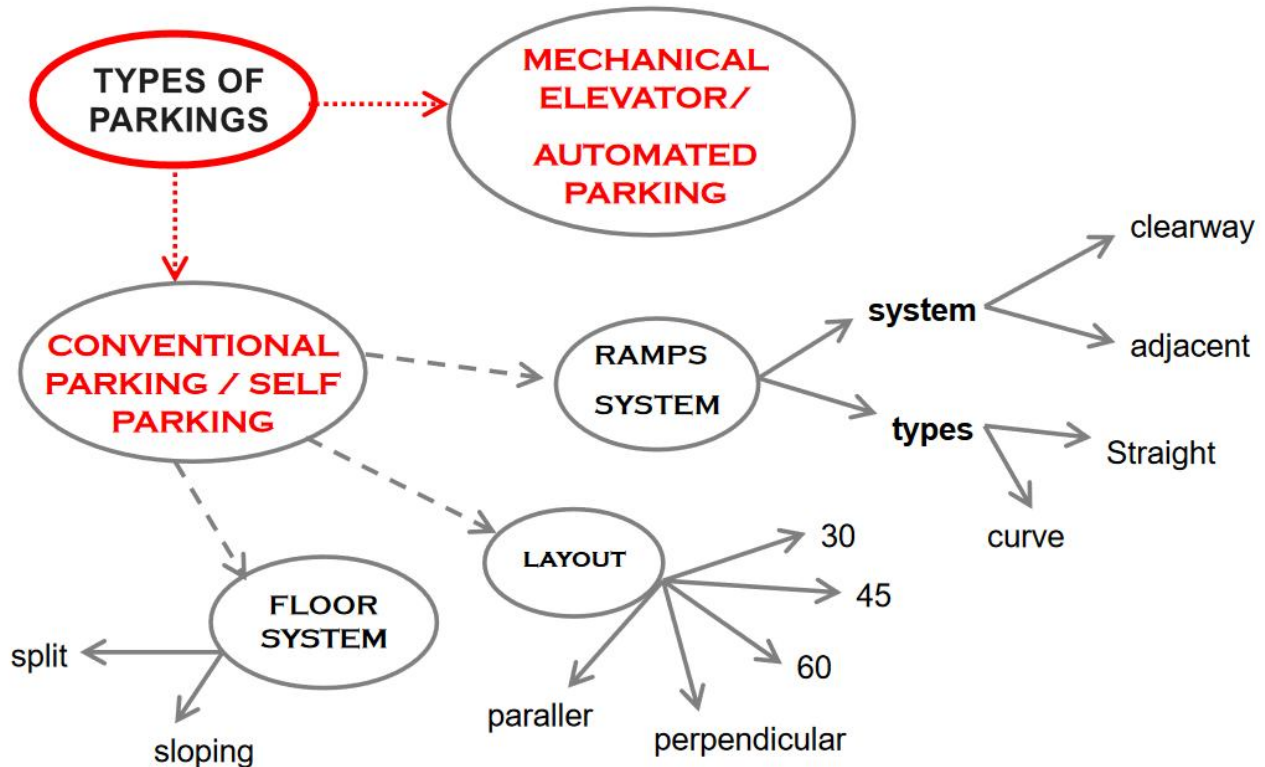


Figure 1.1 – The main types of multi-storey car parkings

Depending on the number of storage places, there are parking lots and garages of small (up to 50 parking slots), medium (50 to 300 parking slots) and large (more than 300 parking slots) capacities.

By location, garages are divided into:

- ✚ underground garages;
- ✚ ground garages;
- ✚ combined garages.

Garages can be separately located or located under buildings or between them. The main types of separately located, built-in and attached garages are shown in Figure 1.2.

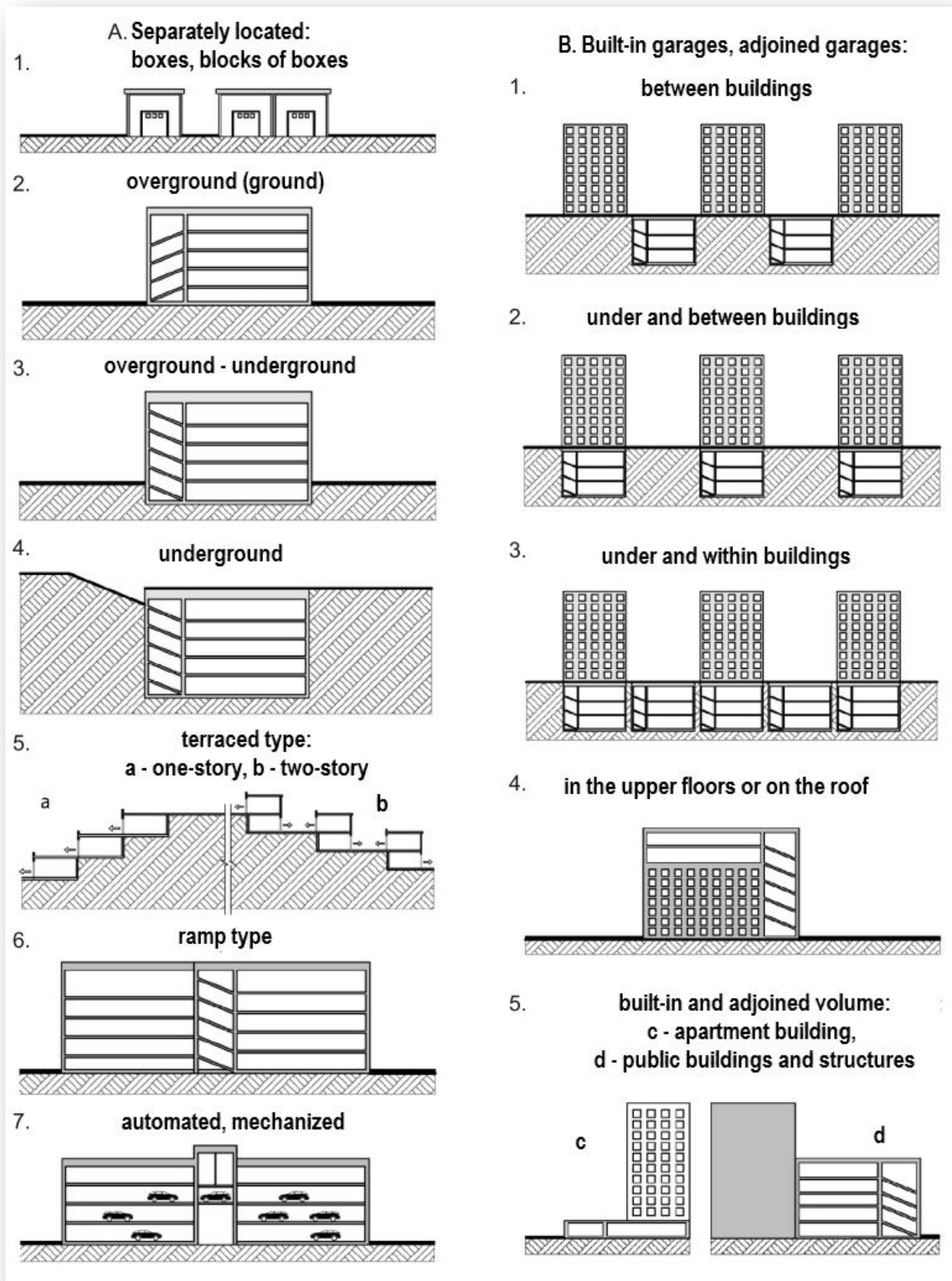


Figure 1.2 – The main types of separately located, built-in and attached garages

COMMON NORMS

For disabled people it is necessary to provide space on the first floors of multi-storey ground and underground garages.

The minimum required area of a particular area for permanent whether temporary storage of cars in open parking lots is determined, based on the norm of 25 m² for the car, and in the garages, depending on their surface, according to table 1.1.

Table 1.1 – Minimum required area for garage






Floors of garages	Building area	The size of the land
	per 1 car place, m ²	
1	25	30
2	15	20
3	10	14
4	8	12
5	6	10
6	5	8
7–9	4	6

Note 1. A vehicle of category 1 up to 6 m in length is accepted as a calculation and up to 2.1 m wide.

Note 2. The figures given in the table also take into account the shunting area (area inland passages that account for one car storage location)

For example: We have 3 floors in the parking lot and 150 car places. So, we need to take a figure from the table from the column ‘building area’. It will be 10 and multiply by the number of cars 150. We get $10 \times 150 = 1\,500$ m² the minimal building area.

The garage must include:

-  premises for staff;
-  premises of sanitary facilities;
-  2 entrances-exits with one-way or two-way traffic;
-  arrangement of an accumulation platform before entering (150 cars \times 10 % = 15 cars);
-  if necessary – fencing of the territory.

2 PRELIMINARY ANALYSIS OF THE PROJECTED AREA

At the first stage of designing a ground garage, it is necessary to choose a site on which construction will be carried out. The site is selected on the existing situational map of the city of Kharkov, taking into account the rationality of placing the parking in this particular area.

When choosing a site, you need to take into account the building density of a given territory, the ability to use free space without dismantling existing facilities, the presence of a sufficient number of residential or commercial premises that need temporary or permanent storage of cars and other factors.

Then the analysis of the territory on which the garage will be located is performed. All schemes and drawings of the project are carried out in the Archicad program. Preliminary analysis includes the development of four schemes:

1. Situational plan.
2. Scheme of urban planning analysis of the territory.
3. Scheme of functional zoning of the territory.
4. Scheme of transport and pedestrian traffics of the district.

Each scheme is executed on a separate A3 format with a frame and the title block. All schemes are carried out in a scale 1:2 000.

2.1 Site selection for preliminary analysis development

Placement of garages and parking lots should be carried out in accordance with the need and possibilities, determined by specific urban planning conditions. When designing garages and calculating the required premises, the following main questions arise first of all: where it is desirable to place the garage, what land plots are available for this, which constructive system is most beneficial?

The lack of parking spaces is especially acute in the shopping and transport centers of cities. Therefore, you should decide on a site for the construction of a multi-storey garage and its capacity. It is best to choose a plot for building a garage in a residential area or a shopping center of the city.

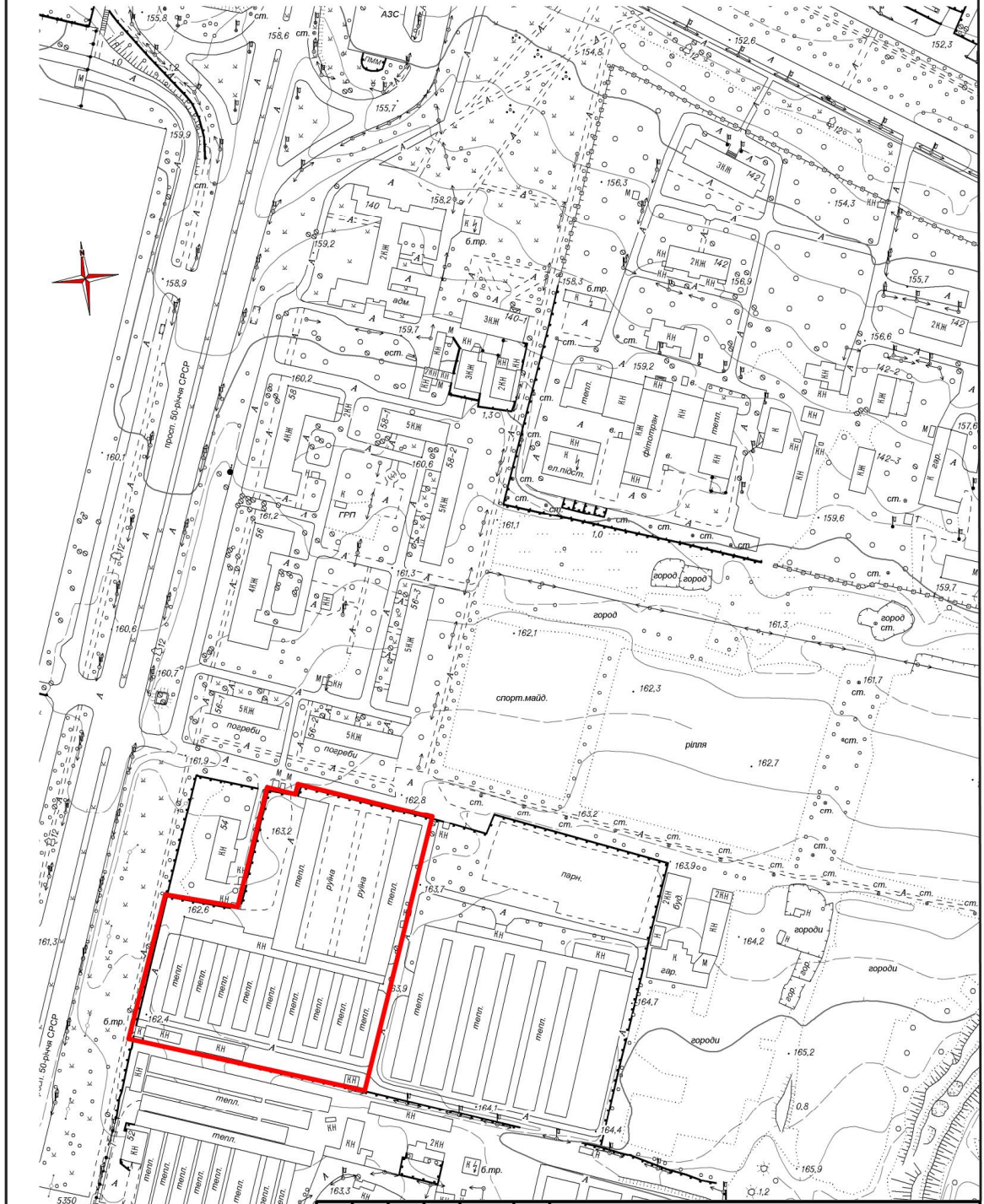
The situational plan is carried out in A3 format, which is drawn up with a frame and a title block. On the situational plan, it is necessary to show a topographic map of that part of the city on which the projected site for the construction of a garage for 150 cars will be located. Mark the boundaries of the lot with a red line.

In the upper left corner, enter the north direction symbol. At the bottom of the format, you need to make symbols. Write the name and scale of the image above the map. Save the file as PDF.


Figure 2.1 shows an example of a situational plan.

Situation Plan

1 : 2000



Symbols

 The Borders Of Territory For Planning

 Direction Of The north

						<i>Course project</i>			
						<i>O.M. Beketov National University of Urban Economy</i>			
Mod.	Amount	Sheet	No. doc.	Signature	Date	<i>Ground garage for 150 cars</i>	Stage	Sheet	Sheets
Done									
Checked				Liubchenko M. Smirnova O. Radchenko A.					
						<i>Situational plan</i>	<i>A2019-3a</i>		

Figure 2.1 – Situational plan

2.2 Development of urban and landscape analysis of the projected territory

When analyzing the urban planning situation and drawing up a scheme of this analysis, students carefully study the development of the site where the construction will be carried out. Determine which buildings are residential and which are non-residential.

One color of different saturation should be used to fill residential buildings of different heights. The higher the number of storeys of the building, the more saturated tone is chosen for painting.

According to this scheme, we can see which area of the city it is, with densely populated residential buildings, industrial or business area. Low-rise or high-rise area.

As in all other schemes, the boundaries of the projected territory are highlighting in color.

Symbols is written at the bottom of the format. Draw rectangles of different saturation and write the number of floors of buildings for a given tone.

In the upper left corner is indicated symbol of the north direction. Above the scheme write the name and scale of the image. The file is saved in PDF format.

In Figure 2.2 shows an example of the scheme of urban planning of the territory.

2.3 Development of functional zoning of the projected territory

At the next stage of the preliminary analysis of the construction site, it is necessary to complete the functional zoning scheme of the territory. In this scheme are shown in different colors the functional zones that are located in the existing territory. These include: residential area, commercial, agricultural, sports, business, entertainment, recreation area, park area, educational and others.

Filling with color is performed in such a way that the topographic map of the area and the objects located on it shine through.

In the upper left corner is indicated symbol of the north direction. At the bottom of the format it is necessary to make symbols. Above the scheme write the name and scale of the image. The file is saved in PDF format.

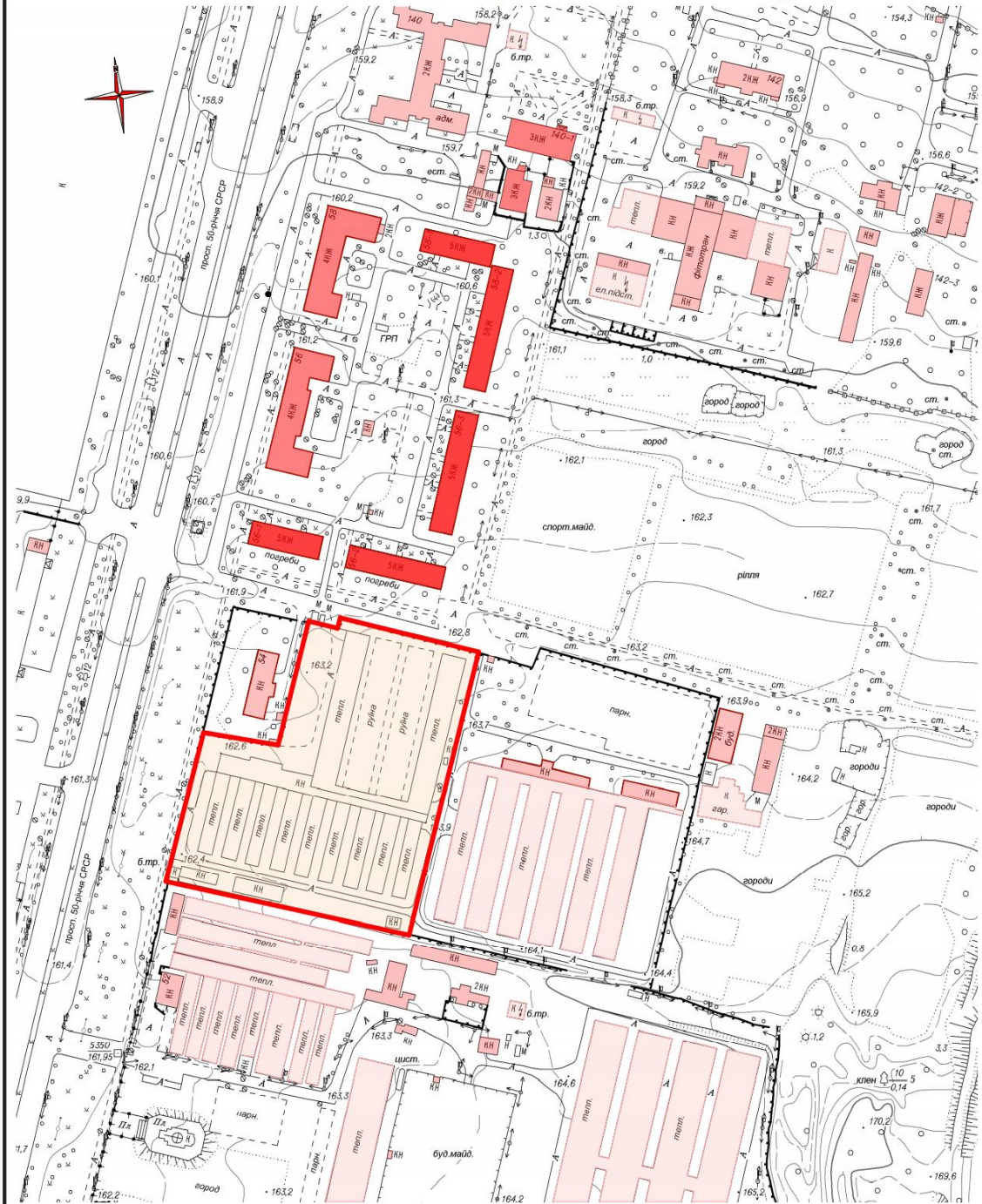
In Figure 2.3 shows an example of the scheme of urban planning of the territory.

2.4 Development of the analysis of the organization of transport and pedestrian traffic of the projected territory

On the scheme of the analysis organization of transport and pedestrian traffic of the projected territory, the major and minor streets and pedestrian roads are highlighted in different colors.

In Figure 2.4 shows an example of the scheme of organization of transport and pedestrian traffic.

Scheme Of Urban Planning Of The Territory S1 : 2000



SYMBOLS

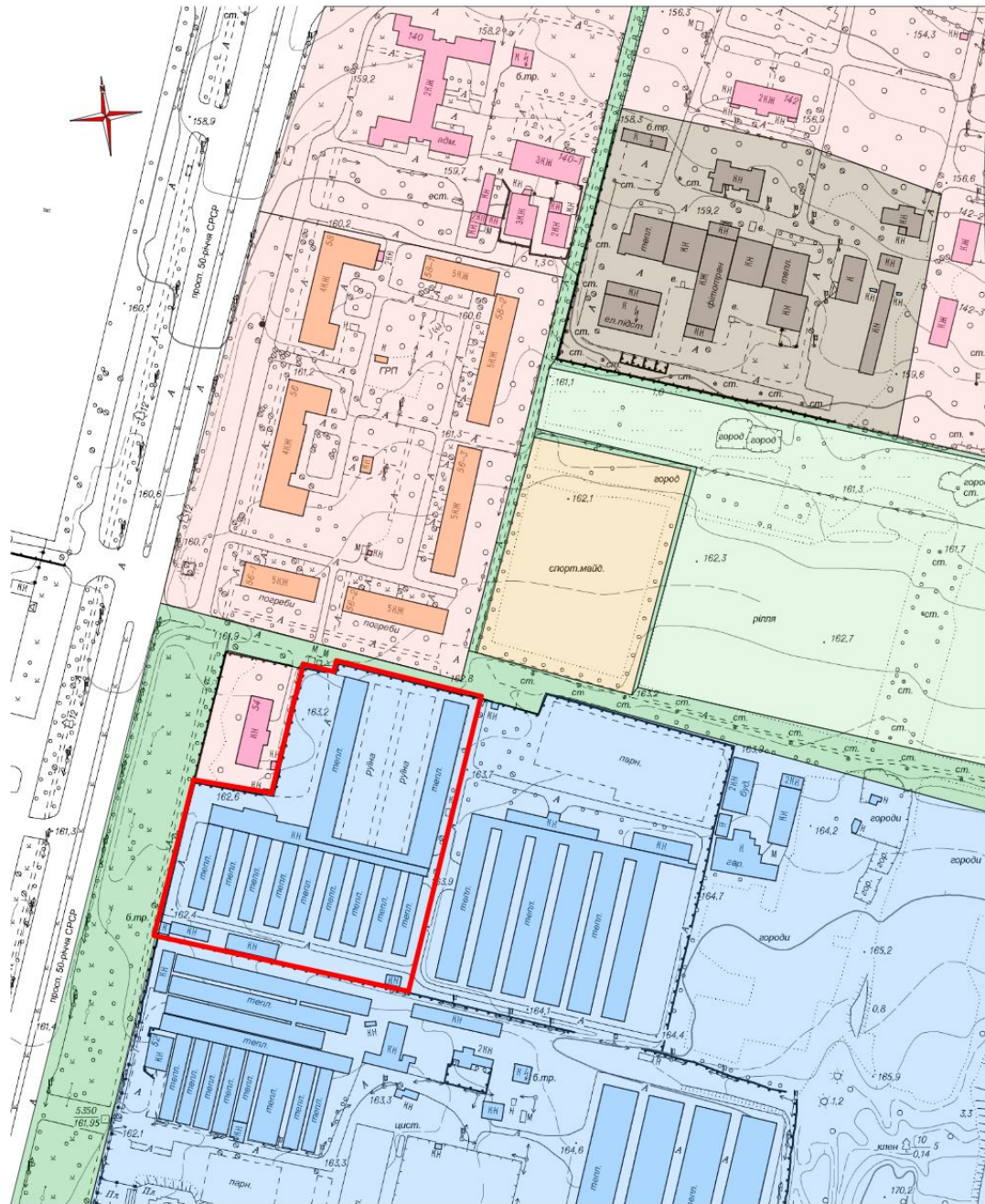
- Borders of the Territory for Planning
- 1 Floor Buildings
- 2 Floor Buildings
- 3 - 4 Floor Buildings
- 5 Floor Buildings
- Direction Of the north

Mtd.	Amount	Sheet	No. doc.	Signature	Date
Done					
Checked				Liubchenko M.	
				Smirnova O.	
				Radchenko A.	

<i>Course project</i>		
<i>O.M. Beketov National University of Urban Economy</i>		
Ground garage for 150 cars	Stage	Sheet
Scheme of urban planing of territory		Sheets
		A2019-3a

Figure 2.2 – Scheme of urban planning of the territory

Scheme Of Functional Planning Of The Territory 1:2000



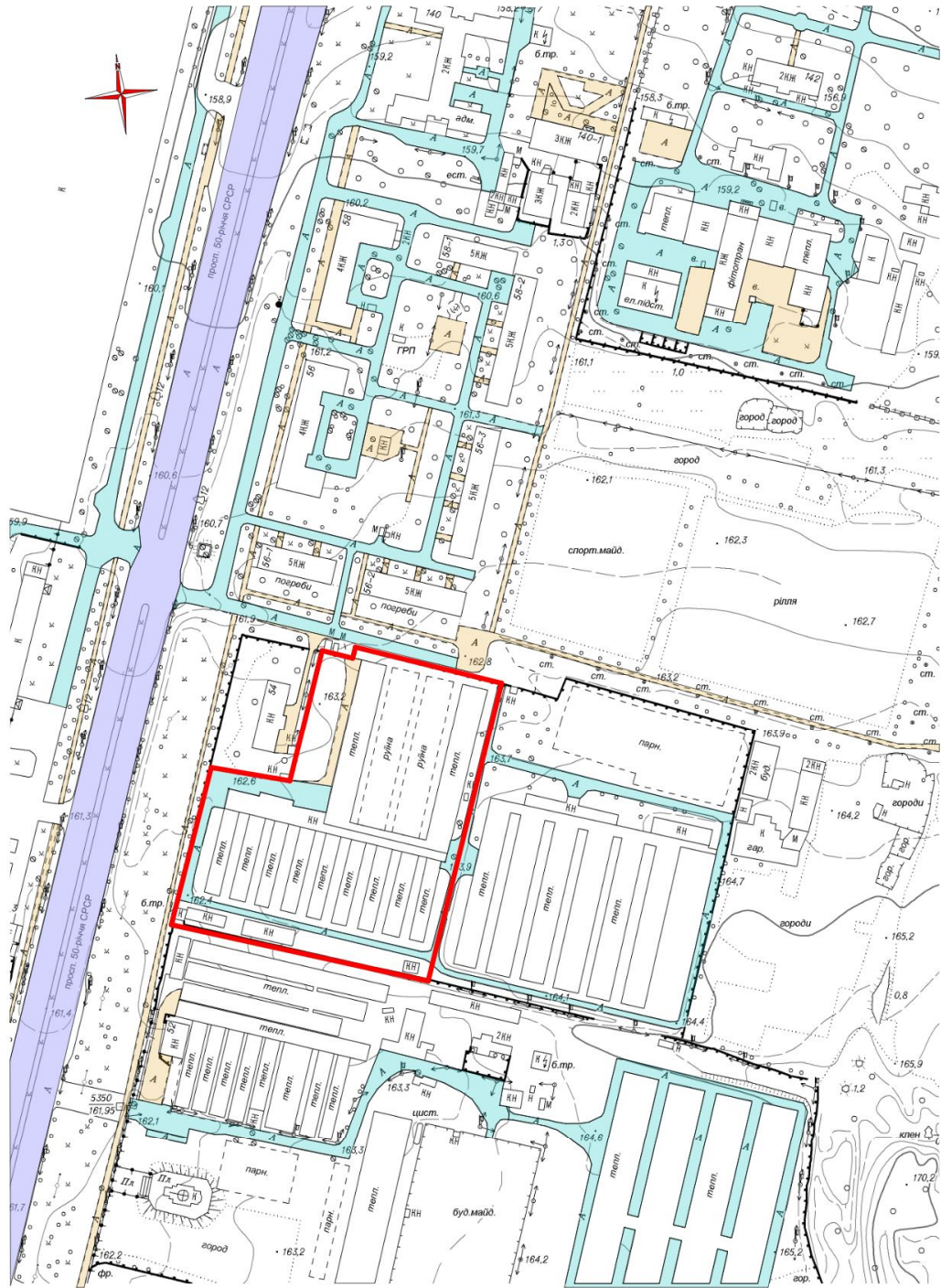
Symbols

- Agricultural Zone
- Natural Landscape Zone
- Sport Zone
- Complex Living And Municipal Average Building Zone
- Recreation Zone
- Commercial Zone
- Direction Of The north

					<i>Course project</i>					
					<i>O.M. Beketov National University of Urban Economy</i>					
Mod.	Amount	Sheet	No. doc	Signature	Date	<i>Ground garage for 150 cars</i>		Stage	Sheet	Sheets
Done						<i>Scheme of functional planning of territory</i>				
Checked				<i>Liubchenko M.</i>						
				<i>Smirnova O.</i>						
				<i>Radchenko A.</i>						
								<i>A2019-3a</i>		

Figure 2.3 – Scheme of functional planning of the territory

Scheme Of Transport And Pedestrian Traffic 1:2000



Symbols

- The Borders Of Territory For Planning
- Major Street
- Minor Street
- side walk
- Direction Of The north

<i>Course project</i>					
<i>O.M. Beketov National University of Urban Economy</i>					
Mod.	Amount	Sheet	No. doc.	Signature	Date
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Checked		Liubchenko M. Smirnova O. Radchenko A.			
<i>Ground garage for 150 cars</i>				Stage	Sheet
<i>Scheme of transport and pedestrian traffic</i>				A2019-3a	

Figure 2.4 – Scheme of organization of transport and pedestrian traffic

3 VOLUME PLANNING AND CONSTRUCTIVE SOLUTION OF GROUND GARAGE FOR CARS

To improve the quality of the development of the master plan, it is necessary to take into account the position, size, relief of the land plot intended for development, to determine the entry and exit routes, if possible, they should not be on bypass roads. If it is impossible to enter and exit the garage from a heavily loaded highway, then it is recommended to orient the facade towards the highway. When designing, it must be remembered that during rush hours, special inconveniences may arise at the entrance and exit from the garage; to ensure a balanced load on the adjacent highway, a parking area should be provided on the territory adjacent to the garage.







Today, numerous garages of various types have been designed and built in the world. The driver judges the garage by the time it takes to drive to the garage and install the car. This time depends on the type of garage and the operating system adopted.

For all garages, the location of driveways is of great importance, as well as the location of accumulation platforms of sufficient size in front of service points and ramps so that cars entering and leaving do not create obstacles to traffic, especially during rush hours.

The location and general plan of the projected object should not contradict the current regulatory documents.



3.1 Development of the master plan of the projected territory

The placement of the garage building - parking in the designated area and the design of the master plan are based on the solution of the following main tasks:

-  maximum use of the site within the land allotment;
-  taking into account the urban planning situation of the construction area;
-  rational organization of entrances and exits to the territory, taking into account the traffic pattern of urban transport on adjacent streets and driveways;
-  taking into account planning restrictions and sanitary and hygienic gaps;
-  organization of the site relief, contributing to the collection and treatment of surface runoff;
-  improvement and landscaping of the allotted area.

GARAGE DESIGNING

Basic requirements for the territory where the garage is located:

-  it should not interfere with transit traffic flows;
-  internal driveways must ensure unimpeded movement in any direction;

✚ improvement of the territory should be decided taking into account the temporary parking of cars;

✚ in front of the garage door, accumulation platforms should be arranged, designed for 10 % of the garage capacity.

The minimum distances from the entrance and exit of the garage should be:

✚ from the intersection of the highway of the city and major streets (from the border of the roadway) – 100 m;

✚ from the intersection of streets and minor streets (from the road border) – 35 m;

✚ from the stop zone of mass passenger transport – 30 m.

Note. Transit through the residential (living) area to a parking lot with a capacity of more than 50 car seats is not allowed.

Assignment “Functional scheme for the master plan”

Before developing the master plan, it is necessary to make a functional zoning scheme for the master plan on A3 format, which should be arranged with a frame and the title block. Place the scheme on a topographic map in scale 1:2000. Show the following elements on the scheme:

✚ projected territory;

✚ outline of the garage building;

✚ in different colors, the main zones that are supposed to be made near the parking building;

✚ the main access roads to the building.

In the upper left corner is indicated symbol of the north direction. At the bottom of the format it is necessary to make symbols. Above the scheme write the name and scale of the image. The file is saved in PDF format.

In Figure 3.1 shows an example of functional scheme for the master plan.

Assignment “Master plan of the ground garage for 150 cars”

The assignment “Master plan of the ground garage for 150 cars” must be performed on A3 or A2 format in the scale of 1:200 or 1:400 depending on the size of the territory. To perform the drawing, you need:

1. Draw the selected area at a scale of 1:200.

2. According to the location of the streets, determine the main and secondary entrances to the territory.

3. Place a garage building on the territory. Make a set around the building.

4. Place driveways and walkways to the garage.

5. Zoning the area. On the site it is necessary to place a platform before entering the garage for 15 cars for cars waiting to enter. Separately make a site for garbage

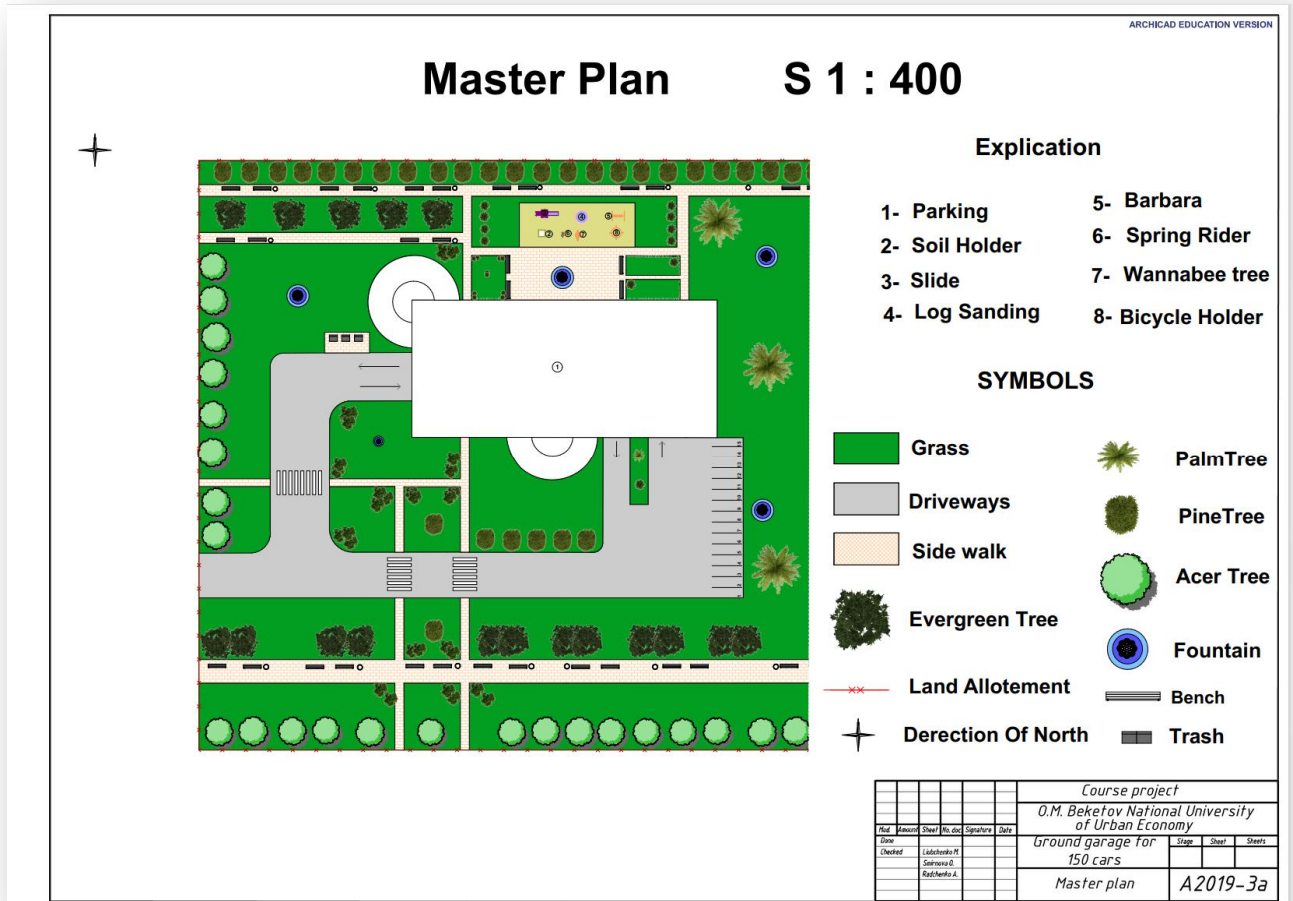


Figure 3.2 – Master plan

3.2 Development of a volume planning solution of the garage for 150 cars

When working on the shapes of a multi-storey garage, it is necessary to pay special attention to proportions, details, finishing materials and the color scheme of the facades. The appearance of the city changes greatly with the appearance of high-rise buildings, one of which may be a garage.

There are many ways to shape the appearance of buildings. The architect can use garages to create the required accents at important points of the street or to identify the technology of the transport process in the square. Particular attention must be paid to the exterior of the garage located in the city center.

REQUIREMENTS FOR VOLUME PLANNING SOLUTIONS OF GARAGES

Ground garages can be provided with a height of not more than 9 floors.

In garages, except for the car storage premises, it is allowed to provide:

- office and warehouse premises;

✚ objects and technical premises for the placement of engineering equipment (transformer substations, thermal station, pump fire extinguishing, cleaning structures, etc.);

✚ car maintenance and washing posts, including self-service posts and car cleaning areas by vacuum cleaner.

Note. In above-ground multi-storey garages, maintenance and repair rooms can be located only on the first and last floors without transit traffic on the floors (when installing isolated ramps).

From each floor (section) of all types of garages should be provided at least two dispersed evacuation exits directly outside or in stairwells. Exterior stairs as evacuation routes should be not less than 1 m wide.

The number of exterior gates for departure (entrance) of cars from storage premises, maintenance posts and vehicles in all types of garages should be taken in the presence in the premises the cars:

- | | |
|---------------------------|--|
| less than 25 (or 25) cars | – one gate; |
| from 25 to 100 | – two gates; |
| more than 100 | – two gates and plus one gate for each next complete or incomplete 100 cars. |
-

In multi-storey garages, for the exit of cars from the second and higher floors, in addition to the number of external gates designed for exit from the premises of the first floor, it is necessary to provide one gate for each lane on ramps or for every two stationary elevators.

Insulated ramps must have a direct exit to the outside. When using uninsulated ramps, it is allowed to carry out cars from the upper floors through the premises of the first floor. In addition to the number of gates on the ground floor, you should additionally take one external gate for each lane on the ramps.

Entrances and exits from garages should be provided with good visibility and arranged so that all cars maneuvers are carried out without obstructing pedestrians and traffic on the adjacent street.

Entrance and exit lanes must be at least 3 m wide; in curved sections the bandwidth increases to 3.5 m.

The dimensions of the exterior gate for entrance or exit are:

- width is 3.0 m;
 - height is 2.3 m when the height of the room is 2,5 m.
-

The movement of cars on entry screw ramps (irrespective of them types) should be projected in a counterclockwise direction.

The movement on exit ramps, depending on their type, may have a clockwise or counterclockwise direction. Preference should be given to the latter.

The paths of cars inside garages must be equipped with signs that guide the driver. Locations of individual cars, their numbers, as well as direction indicators must be marked on the roadway or posted on the boxes.

Car storage may be designed without natural light or with insufficient natural light.

The minimum dimensions for storage of cars in garages should be taken: length of parking space – 5,0 m, width – 2,5 m (for disabled people who use wheelchairs – 3,5 m).

The most economical area per car is a garage-type garage with a perpendicular location of cars to the axis of travel.

In garages of open type is allowed bilateral placement of cars at an angle of 45–60° to a longitudinal axis of travel at observance of the sizes of places of storage and internal passages not less than resulted in tables.

Along the walls to which cars frontal and longitudinal sides are stood, wheel mounting devices with a height of not less than 0,12 m should be provided.

The height of the premises for storage of cars from the floor to the bottom of the protruding building structures and suspended equipment must exceed by at least 0,2 m the height of the tallest car and be not less than 2,0 m.

In garages with two or more floors to move cars vertically it is necessary to provide isolated (attached) or insolated (built-in) from car storage premises ramps or sloping floors.

The number and type of ramps and, accordingly, the number of required exits in the garage is determined by the number of cars located on all floors except the first:

- ✚ up to 100 inclusive – one single-lane ramp;
 - ✚ more than 100 to 1000 – one two-lane or two one-lane ramps;
 - ✚ more than 1000 – two two-lane ramps.
-

The following requirements must be observed to designing ramps:

✚ the longitudinal slope of closed rectilinear ramps along the axis of the lane should be not more than 18 %, curvilinear ramps – not more than 13 %, longitudinal slope of open and not protected from precipitation ramps – not more than 10 %;

✚ the transverse slope of the turns of curvilinear and rectilinear ramps should be not more than 6 %;

✚ the connection of the ramps with the horizontal sections of the floor should be smooth and the distance from the bottom of the car to the floor should be not less than 0,1 m;

✚ on both sides of the ramp roadway should be wheel-mounted devices (barriers) with a height of 0,1 m and a width of 0,2 m; the middle barrier separating the carriageways of the two-lane ramp must be at least 0,3 m wide;

✚ on ramps with pedestrian traffic on one side a sidewalk not less than 0,8 m wide shall be provided (on curved ramps the sidewalk shall be located on the inside).

The width of the ramps roadway is determined by Table 3.1

Table 3.1 – Sizes of ramp

Types of ramps	Width of the ramps roadway
Straight one strip	Maximum car width plus 0,8 m, but not less than 2,5 m
Straight two strip	Double the maximum width of the car plus 1,8 m, but not less than 5 m
Curved one strip	Width of the largest car plus 1 m, but not less than 3,1 m
Curved two strip	Double the width of the largest car plus 2,2 m, but not less than 6,2 m

PLACEMENT CARS IN GARAGES

Schemes of placement cars in garages are shown in Table 3.2.

Table 3.2 – Placing of cars in garage

<p style="text-align: center;">ANGLE 90°</p> <p>Effective in low turnover rate or long term parking areas, the perpendicular, or 90 degree parking configuration is the most efficient and economical since it accommodates the most vehicles per linear meter.</p> <p>Advantages: works well with either one-or two-way aisles; handles the most vehicles per square meter of pavement; handles most vehicles per linear meter.</p> <p>Disadvantages: requires widest area; difficult maneuvering for some drivers; two-way traffic can create some visibility problems.</p>	<p style="text-align: center;">16,9 m</p> <p style="text-align: center;">5,4 m 6,1 m 5,4 m</p> <p style="text-align: center;">90°</p> <p style="text-align: center;">5,3 m</p>
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ANGLE 60°

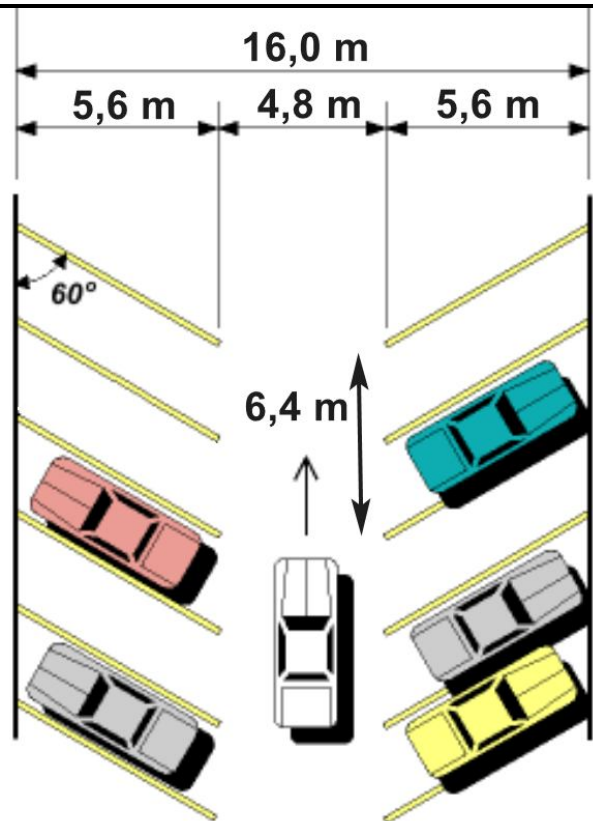
Ideal for a fast turnover rate or predominantly short term use-often offset by difficulties of inefficient circulation patterns and one-way aisles.

Advantages:

in and out of parking spaces; good visibility; lends itself to either one-or two-way aisles; most common short term parking configuration.

Disadvantages:

requires more pavement per vehicle than perpendicular configuration; handles less vehicles per linear meter.



ANGLE 45°

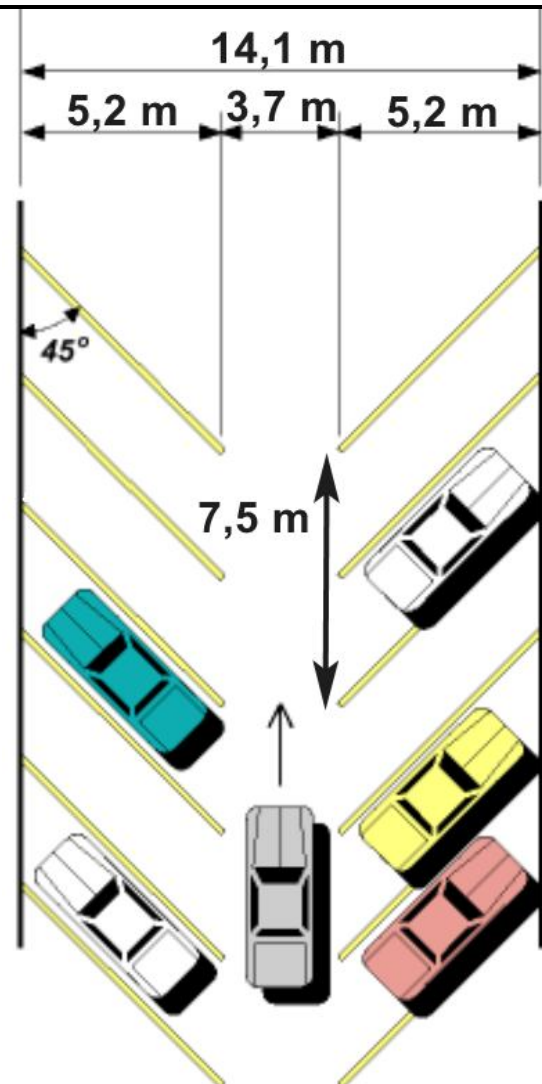
The 45 degree angled parking configuration displays similar benefits and limitations as the 60 degree.

Advantages:

reduced width requirements for layout; easy maneuvering in and out of parking spaces; good visibility to the rear.

Disadvantages:

doesn't work well with two-way aisles; requires more pavement per vehicle than perpendicular parking configuration.



There are dimensions (protective zones) of cars and widths of internal passage in the premises of their storage in Table 3.3.

Table 3.3 – The distance between cars and structural elements of buildings and constructions

Protective areas	Symbol	Distance to cars	Scheme
		at storage places	
From the frontal side of the car to the wall	a	0,5	
The same, to stationary technological equipment	B	–	
From the longitudinal side of the car to the wall	c	0,5	
Between the longitudinal sides of the car	d	0,6	
Between the car and the column	f	0,3	
From the frontal side of the car to the gate	e	0,5	
Between cars which stand one by one	-	0,4	

To designing administrative block of garages it is necessary to do following premises:

Premises of 1 floor:

-  car storage area with floor number and parking slot;
-  checkpoint;

- ✚ premises for inventory;
- ✚ staff room;
- ✚ office;
- ✚ security room;
- ✚ electric board;
- ✚ fire extinguishing station;
- ✚ WC for men (2 rooms);
- ✚ WC for women (2 rooms);
- ✚ WC for staff (1 room);
- ✚ WC for disabled people (1 room) (near disabled parking slots).

Premises of 2 floors and other floors:

- ✚ car storage area with floor number and parking slot (Ex: 2–05, 2–42, 3–14);
- ✚ premises for inventory;
- ✚ WC for men (1 room);
- ✚ WC for women (1 room).

Assignment “Floor plans of the garage”

Assignment “Floor plans of the garage” performed on separate sheets of A3 or A2 format in the scale 1:100 or 1:200, which should be arranged with a frame and the title block.

You need to do the following:

1. Draw coordination axes.
2. Draw the external and internal walls with binding to the coordination axes, partitions.
3. Show windows and doors with opening.
4. Draw stairs and a ramp.
5. Write the required dimensions in mm.
6. Show the number of parking place. For example, for 1-st floor use (1–25, 1–32), for 2-nd floor (2–15, 2–20) etc.
7. Write the premises numbers.
8. In the free space of the drawing write: “Explication of the premises:” and write the list of numbered premises.
9. Above the plan write the name and drawing scale.
10. Fill in the title block.

An example of the garage floor plan is shown in the Figure 3.3.

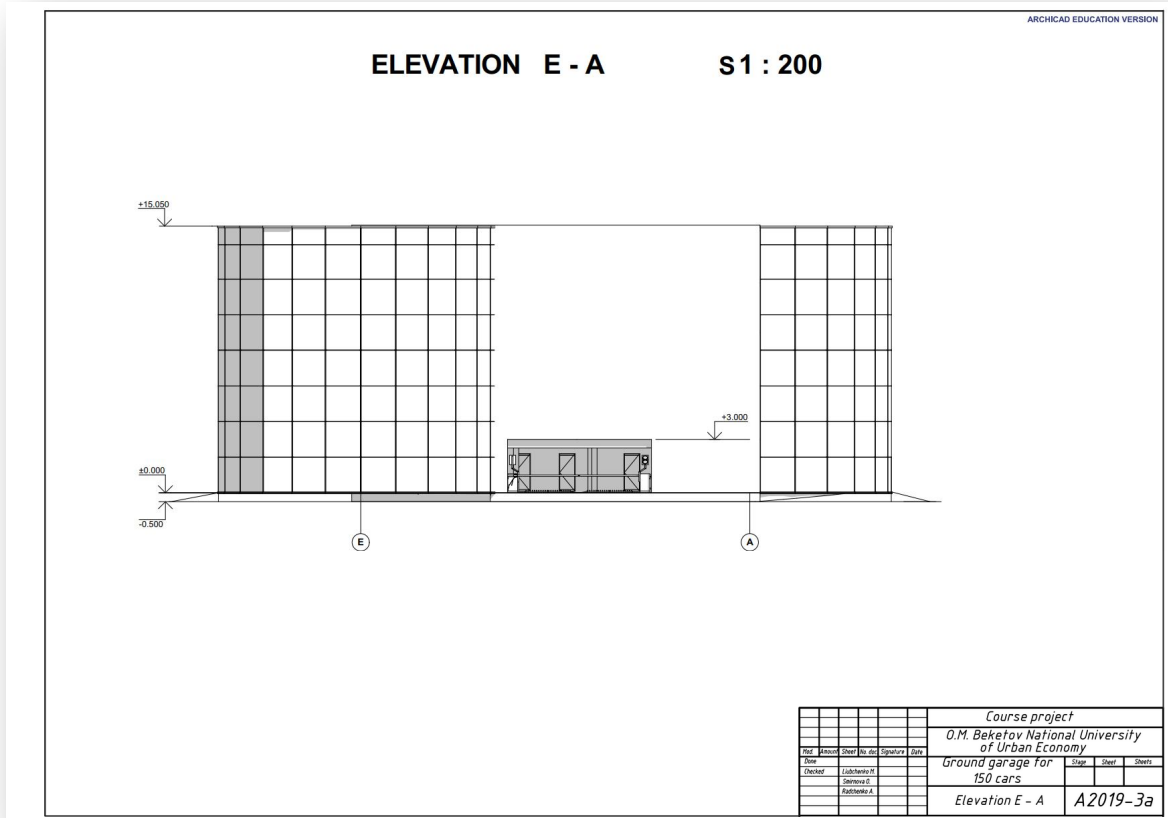


Figure 3.4 – Example of the elevation of garage

All drawings must be filled with a title block. The title block is placed in bottom right corner of the drawing sheet. The dimensions of the title block are shown in the Figure 3.5. An example of filling the title block is shown in the Figure 3.6.

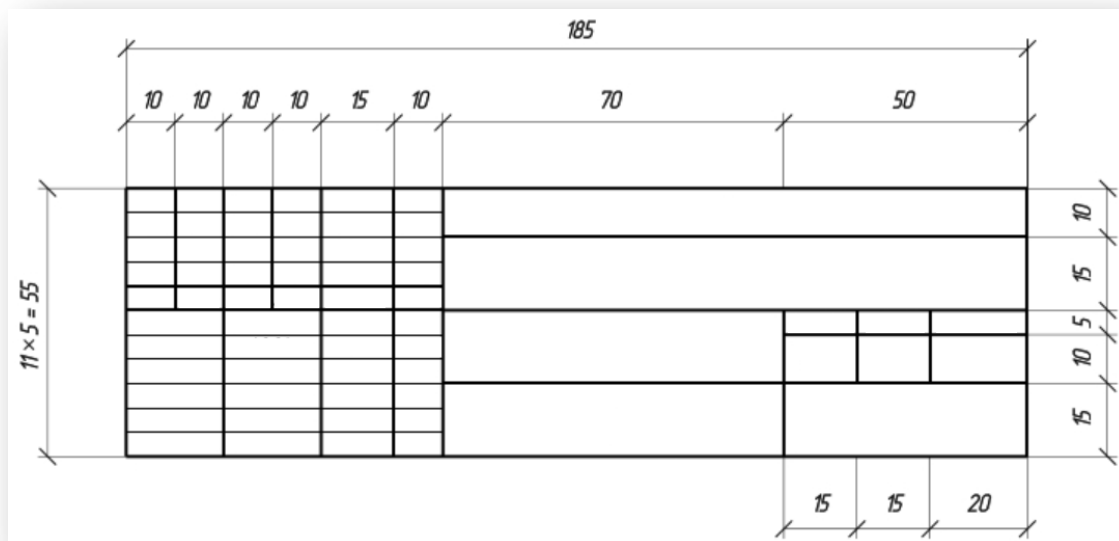


Figure 3.5 – Title block dimensions for construction drawings

						<i>Course project</i>			
						<i>O.M. Beketov National University of Urban Economy</i>			
<i>Mod.</i>	<i>Amount</i>	<i>Sheet</i>	<i>No. doc.</i>	<i>Signature</i>	<i>Date</i>	<i>Ground garage for 150 cars</i>	<i>Stage</i>	<i>Sheet</i>	<i>Sheets</i>
<i>Done</i>									
<i>Checked</i>		<i>Liubchenko M.</i>							
		<i>Smirnova O.</i>							
		<i>Radchenko A.</i>				<i>1st floor plan</i>	<i>A2019-3a</i>		

Figure 3.6 – Fill in title block of floor plan drawing

3.3 Constructive solution of parking for 150 parking spaces

THE SKELETON OF GARAGES

For parking garages in the practice of design and construction, various design solutions are used. The choice of a constructive solution depends on a number of factors:

- ✚ placement in urban areas;
- ✚ the shape and size of the site allocated for the construction;
- ✚ type of the garage;
- ✚ architectural and space-planning solutions;
- ✚ estimated cost of parking space;
- ✚ organization of construction.

For bearing and enclosing structures of multi-storey underground and above-ground parking garages, durable and fireproof materials are used: reinforced concrete, steel, brick.

Currently, various structural schemes are used in garage construction: frame, panel, with load-bearing walls made of small-piece products, combined. In most cases, frame buildings are erected.




The load-bearing frames of the parking garage buildings are made of reinforced concrete, steel or combined. The steel frame is used in ground garages - parking lots of all types. It is most effective for parking garages with manege storage, including open ones. Steel structures allow you to easily and economically cover large spans or can have a grid of columns in exact accordance with the dimensions and parameters of the elements of the space-planning structure of the garage.

In parking garages with a skeleton made of metal and monolithic reinforced concrete, the floors are usually monolithic. The use of a monolithic floor is advisable with a complex configuration of the building plan.

When erecting parking garages from precast concrete products with unified dimensions, it must be borne in mind that they may not correspond to the parameters of individual storage locations and the storage area as a whole. This is especially true for curved ramps, in which not only the dimensions, but also the shape of the plan do not allow, in full measure, to use typical precast reinforced concrete elements.

GARAGE FOUNDATIONS

For the foundations of multi-storey parking garages, the following types are used:

-  columnar foundations on a natural base;
-  solid slab on a natural base;
-  pile foundations.

Strip foundations can also be used.

Columnar foundations

Columnar foundations for columns of multi-storey garages are designed as prefabricated or monolithic step-type, the slab part of which has no more than three steps. The connection between the foundation and the steel column is shown in the Figure 3.7.

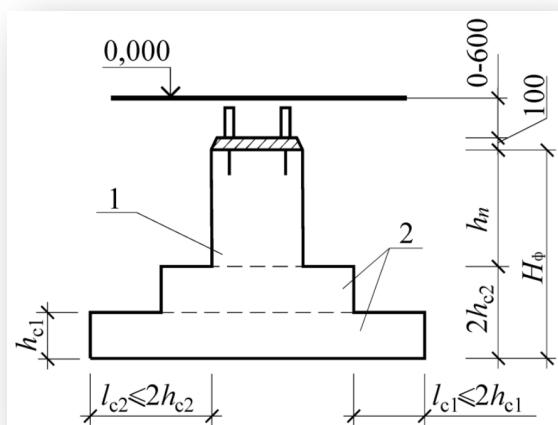


Figure 3.7 – Column foundation when connected to a steel column

Tape foundations

In the event that the soles of foundations of adjacent columns required by the calculation are close to each other, strip foundations are used under the rows of columns in the form of separate belts or in the form of cross belts (Figure 3.8). Also, strip

foundations are used for inhomogeneous soils or sharply different loads, since they level the subsidence of the base. The use of a strip foundation for a steel frame is a solution that is not often found in mass construction.

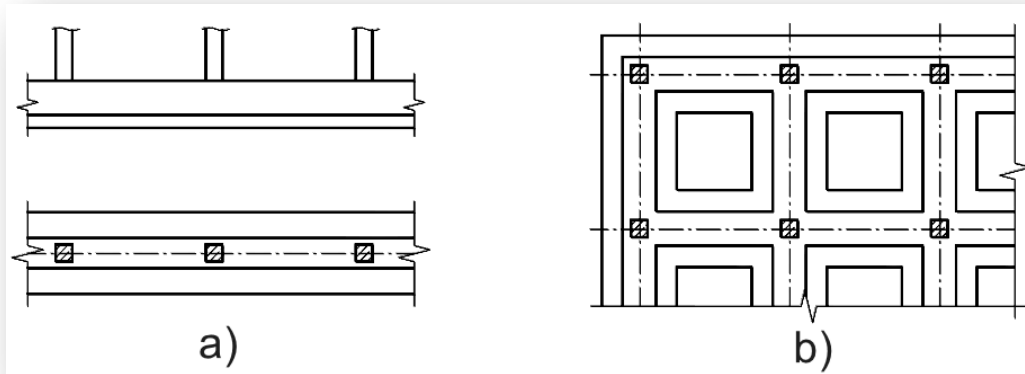


Figure 3.8 – Monolithic tape foundations for columns:
a – separate tapes; b – cross tapes

Solid foundations

For buildings of significant height, the area of tape foundations may not be enough. In this case, solid foundations are arranged. Such foundations to a greater extent even out subsidence than tape foundations, therefore they are also used for weak and heterogeneous soils or sharply uneven loads.

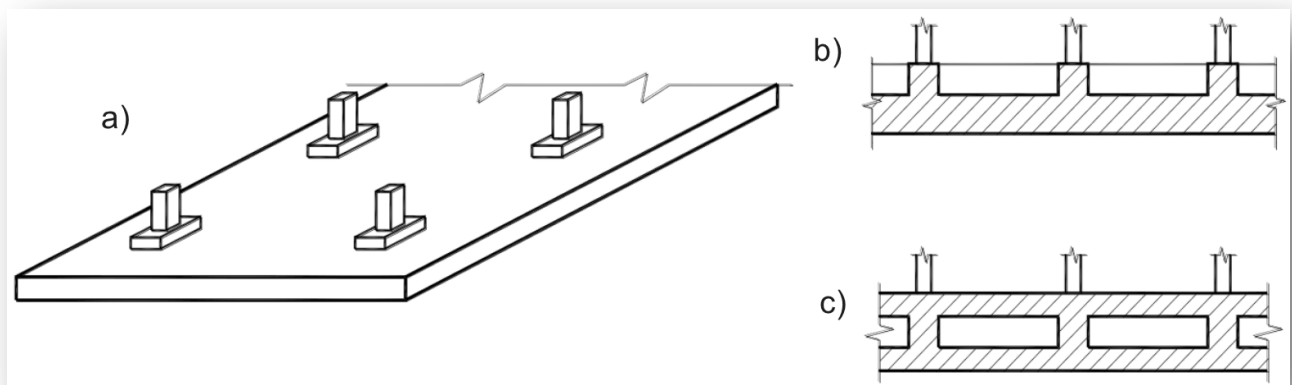


Figure 3.9 – Solid foundations for columns:
a – slab-beamless; b – slab-and-beam; c – boxed

COLUMNS

When designing multi-storey parking garages, *metal columns* of a Double-T profile or closed profile, reinforced concrete of rectangular or circular cross-section, as well as steel-concrete columns can be used. The most reasonable is the use of metal structures in the design of open parking garages of a manege type up to 6 floors.

Reinforced concrete prefabricated or monolithic columns in multi-storey parking garages, as a rule, are used in underground floors.

Pipe-concrete columns are used with large column spacing. A pipe-concrete column is an outer steel shell (metal pipe) filled with concrete, if necessary reinforced, forming an inner core. The steel cage is designed not only as formwork and simultaneously longitudinal and transverse reinforcement, but also creates ideal conditions for the concrete core to work under load.

The column spacing is one of the most important planning and design indicators. It is recommended to take the spacing of the outer columns equal to the width of several parking spaces. Variants of the arrangement of columns with a manege arrangement of parking spaces are shown in the Figures 3.10.

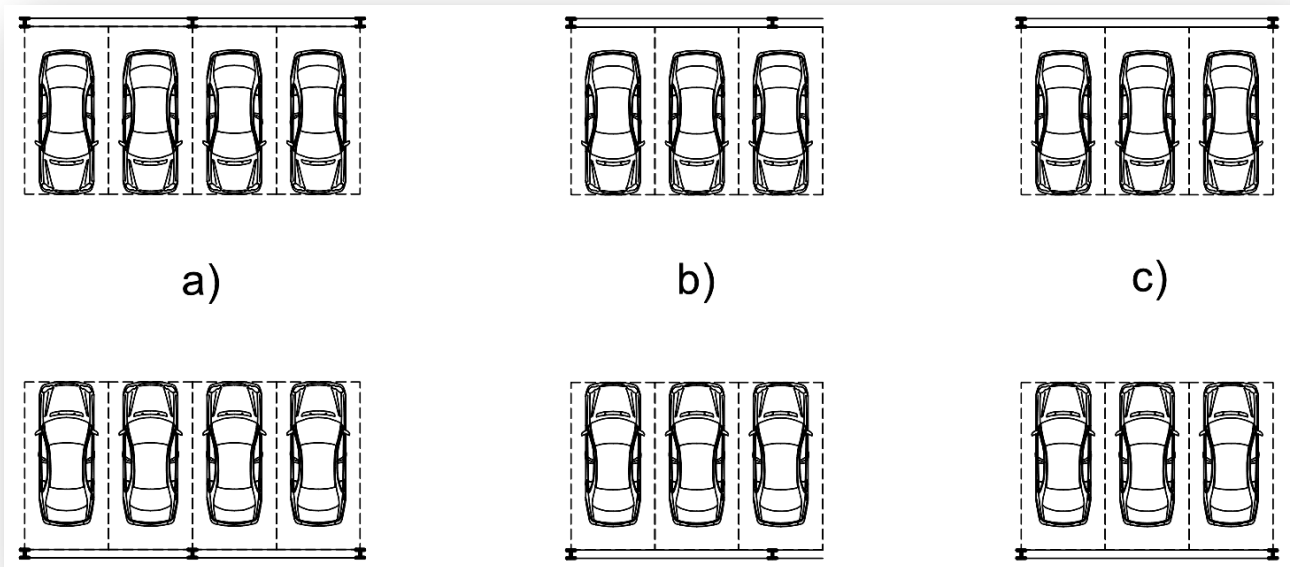


Figure 3.10 – Fragments of plans with manege arrangement of middle-class cars at an angle of 90: a – the main beams for 2 rows of cars. The column spacing is equal to 2 parking spaces; b – the main beams for 2 rows of vehicles. Column spacing 6 m (independent of the parking space); c – the main beams for 2 rows of cars. Column spacing is equal to 3 parking spaces

Crossbars in the form of metal beams allow covering spans up to 18 meters and are used in skeleton buildings with both reinforced concrete and metal columns.

STAIRS

The following constructive solutions of stairs are used:

- ✚ prefabricated or monolithic reinforced concrete marches and platforms;
- ✚ precast reinforced concrete steps along steel stringers;
- ✚ steel stringers, treads and platforms.

ROOFS

For roofs of parking garages, the following design solutions are used:

- ✚ insulated or not-insulated flat unexploited roofs (with a roof covering made of rolled or mastic materials);
- ✚ flat operated roofs (depending on the design load – for pedestrian or car traffic);
- ✚ flat or pitched roofs with landscaping (with intensive or extensive landscaping);
- ✚ insulated or not-insulated pitched roofs (can be made of sandwich panels, monopanels; with a roofing system with a roof made of profiled sheets, or with a metal seam roof and other materials for pitched roofs).

EXTERNAL ENCLOSING STRUCTURES AND PARTITIONS

In multi-storey parking garages with a steel skeleton, the enclosing structures are designed in the form of fences that provide through ventilation (for open parking garages), or in the form of curtain walls (panel).

In heated parking garages, the enclosing structure is made using modern insulation systems, as well as in the form of a wall made of small-piece products with a middle layer filled with effective insulation.

Under the required unheated storage conditions for cars in closed unheated parking garages, profiled wall and walls made of small-piece products are used.

In open parking garages, lattice or mesh fences, facade “metal blinds”, perforated sheets and other architectural solutions are used. External fences can be made both for the entire height of the floor (all kinds of grids, gratings and blinds), and in the form of a protective fence 1 m high (solid parapet, metal lattice fences).

The most economical are open parking garages, due to less rigid fire-fighters requirements, savings in the device of external walls and engineering systems.

The following types of partitions are used in parking garages:

- ✚ skeleton partitions;
- ✚ made of small-sized materials, such as ceramic or sand-lime bricks or aerated concrete blocks.

RAMPS

The types of ramps most commonly used in garages are shown in the Figure 3.11.

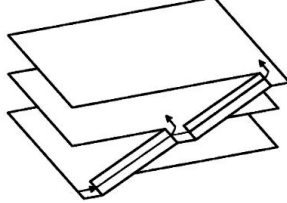
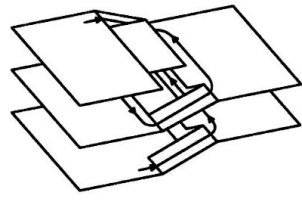
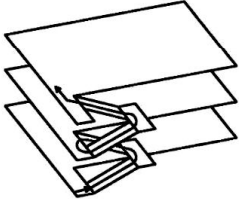
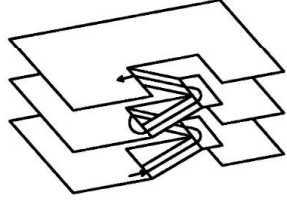
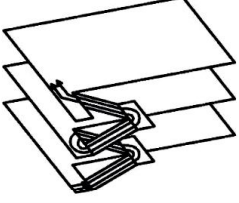
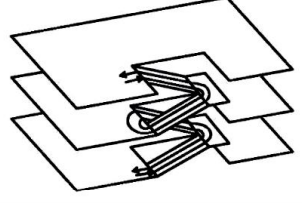
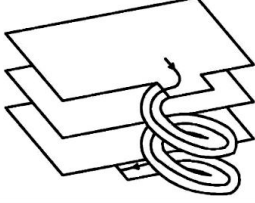
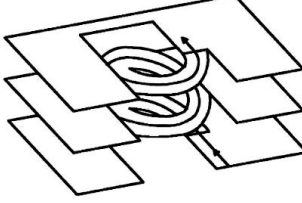
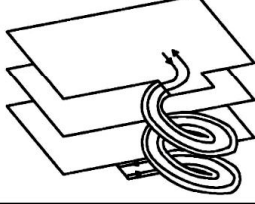
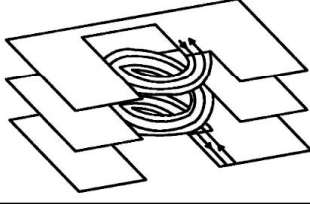
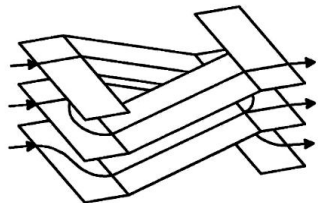
Attached	Built-in
Straight-line single-flight	Straight-line double-flight
	
Straight-line single-track double-flight	
	
Straight-line double-track double-flight	
	
Curvilinear single-track	
	
Curvilinear double-track	
	
Two-way screw	
	

Figure 3.11 – Types of ramps

Figures 3.12 – 3.15 show the minimum horizontal projections of the ramps most often used in the practice of designing multi-storey parking garages.

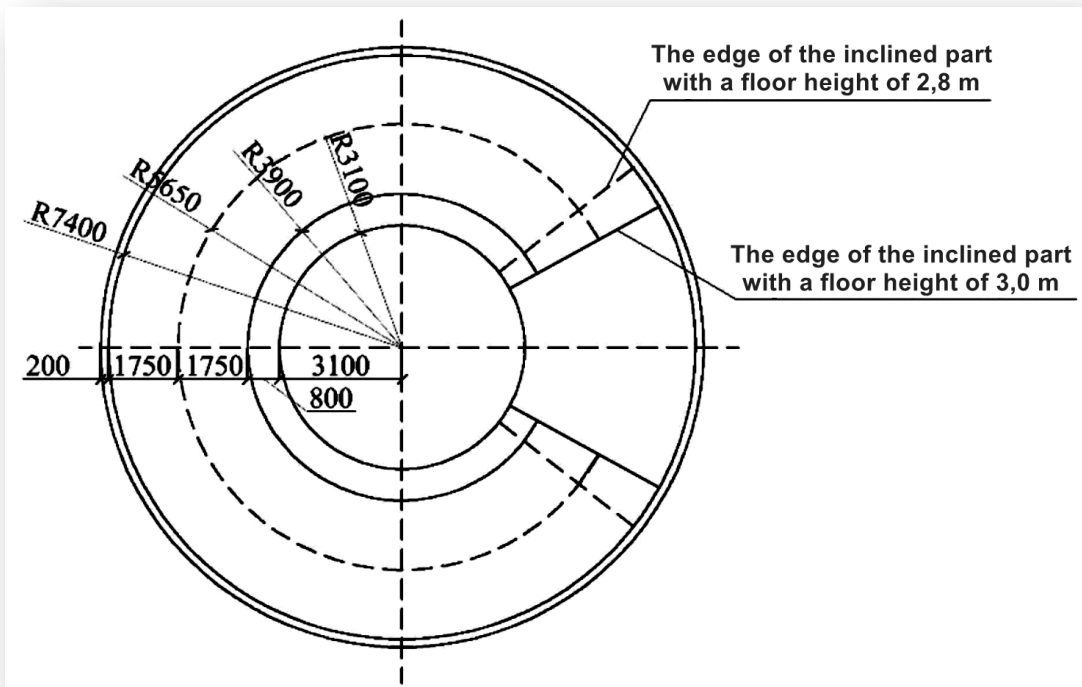


Figure 3.12 – Minimum horizontal projection of a single track curved ramp

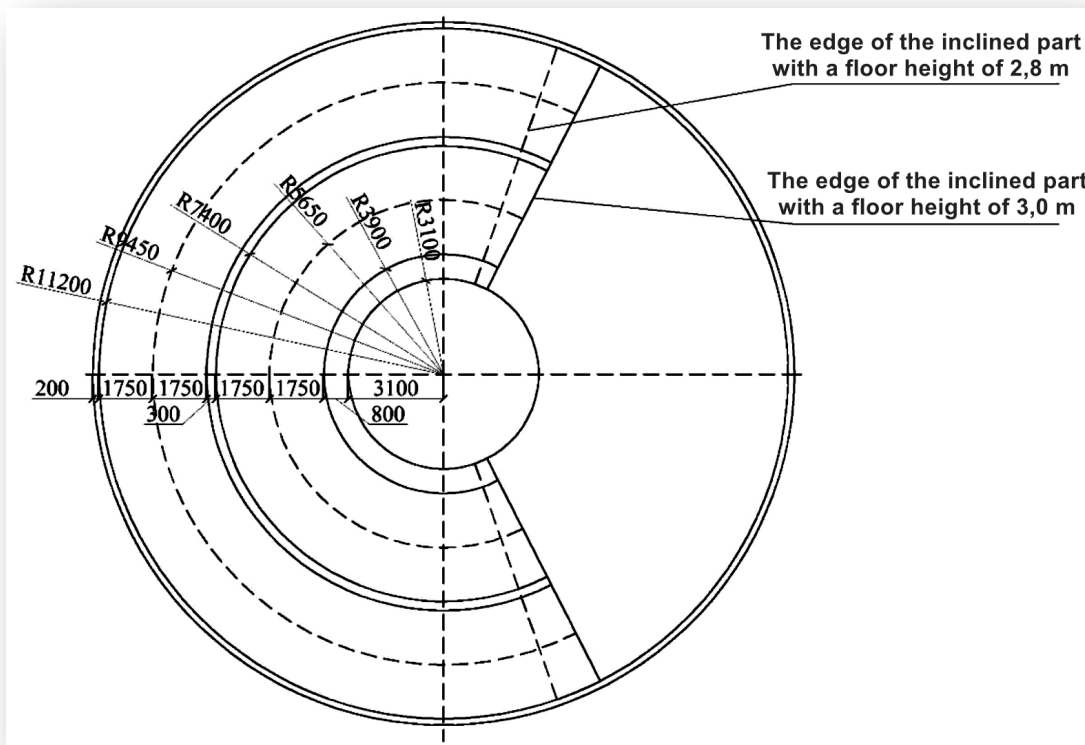


Figure 3.13 – Minimum horizontal projection of a double-track curved ramp

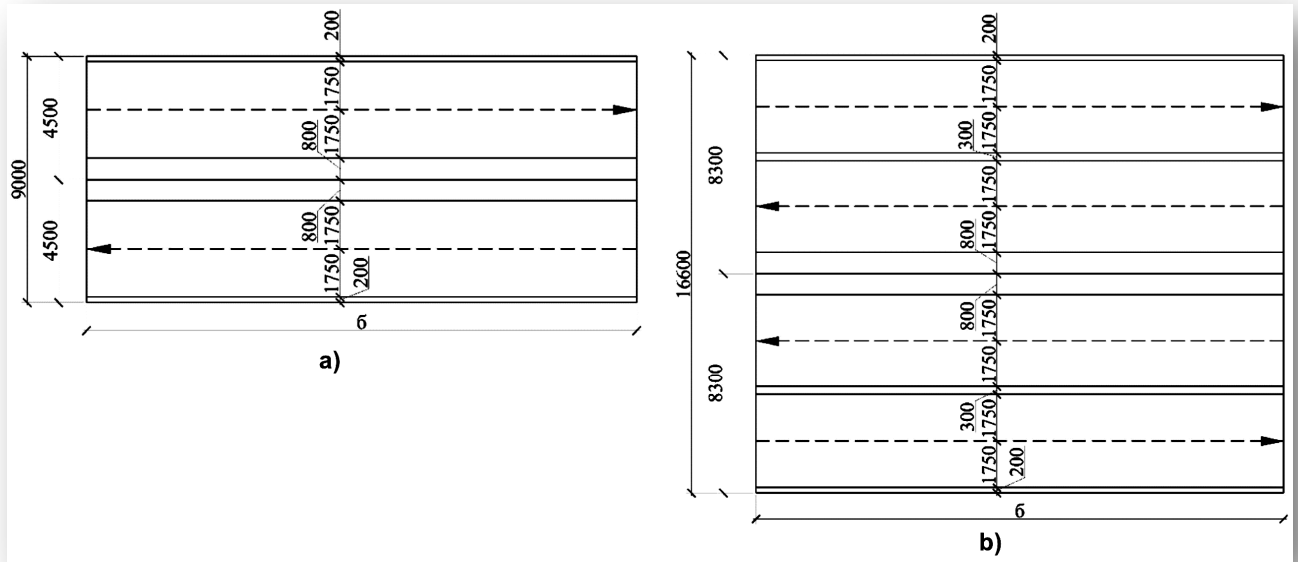


Figure 3.14 – Minimum horizontal projection of a straight half-ramp:
 a – single-track; b – double-track

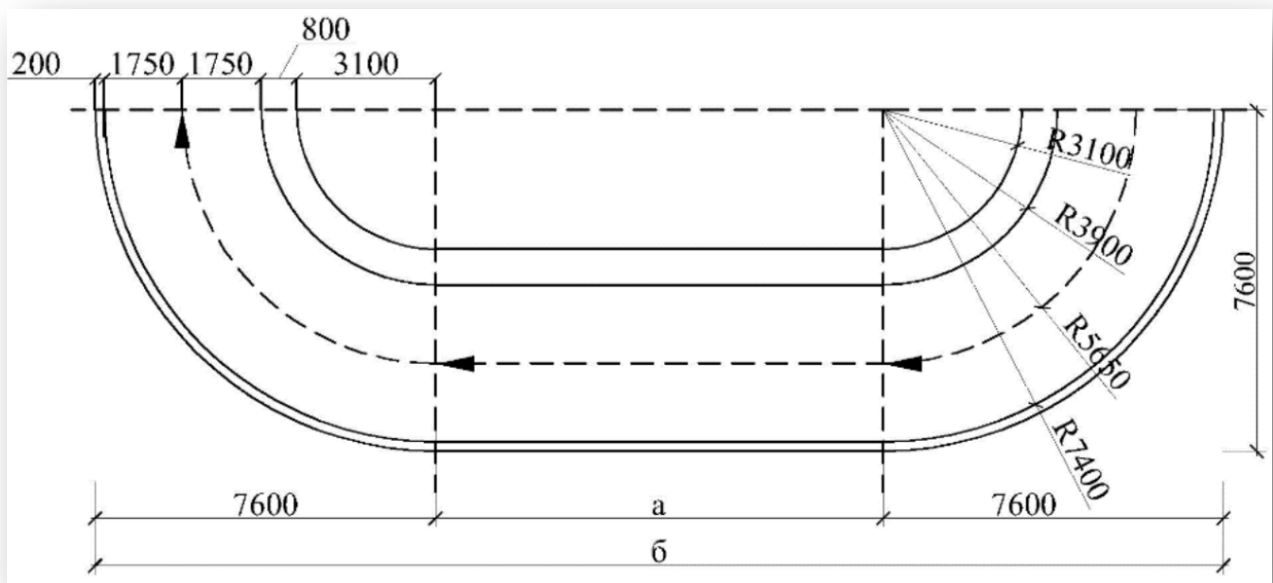


Figure 3.15 – Minimum horizontal projection of a single-track straight single-flight ramp

4 VISUALIZATION AND DESIGN OF THE PROJECT “GROUND GARAGE FOR CARS FOR 150 PARKING PLACES”

4.1 Visualization of parking for 150 cars with surroundings and internal space of the parking lot

3-D visualization is an important component of any project for a visual representation of the space-planning solution and at the last stage for its presentation to the customer. ArchiCAD has many tools for creating high quality real world renderings.

To begin with, you need to carefully consider the appearance of the building and the details of the environment. Decide with the color scheme so that it does not create dissonance with the rest of the territory. Think over the elements of landscaping and improvement.

Look at your building from different angles and choose 2–3 of the most successful images. Place them on one sheet. Draw a frame and fill in the title block.

Then, take some perspective views of the interior of the garage with the vehicles in parking spaces or while driving on a ramp. Pick the best 2–3 images and place them on the second sheet. Draw with a frame and title block too.

In the assignment **“Visualization of parking for 150 cars”** it is necessary to show 2–3 visualizations of the garage from different angles and the nearest territory. Place the 3D images on a standard sheet, draw a frame and title block. Fill the title block.

An example of the assignment is shown in the Figure 4.1.

VISUALISAIONS OF THE INTERIER OF PARKINGS



						<i>Course project</i>		
						<i>O.M. Bekefov National University of Urban Economy</i>		
<i>Mod.</i>	<i>Amount</i>	<i>Sheet</i>	<i>No. doc.</i>	<i>Signature</i>	<i>Date</i>			
Checked		Liubchenko M.				<i>Ground garage for 150 cars</i>		
		Smirnova O.				Stage	Sheet	Sheets
		Rudchenko A.				<i>Visualization of the interior of the garage</i>		
						A2019-3a		

Figure 4.2 – Example of visualization of the interior of the garage

4.2 Implementation of project “Ground garage for cars for 150 parking places”

Assignment “Project of Ground garage for cars for 150 parking places” is carried out on the A0 format, is made out by a frame and the title block.

The design of the project on one sheet is of great importance for its presentation to the customer and is therefore an important part of the assignment. The design style can be arbitrary at the request of the architect. You can experiment with color, background, font.

The following elements must be placed on the format:

1. Situational scheme with a dedicated plot for construction in the scale of 1:2000, located at the top left of the format.
2. General plan of the garage territory in the scale of 1:200, located in the left part of the format. Place symbols to the general plan nearby to the image.
3. Four facades of a ground garage in the scale of 1:100. Located at the top of the format.
4. Garage plans for the 1st, last and typical floors in the scale of 1:100 or 1:200 if the building is large. Located in the central part of the format. Nearby to the plans to place an explication of the premises of each floor.
5. Two, three visualizations of a ground garage with the environment. Are located in any free place of a format.
6. One, two visualizations of an internal space of the parking lot.
7. Above each image write the name of the image and the scale in which it is made.
8. At the top of the format write the name of the project.
9. In the upper left corner of the format show the north direction.

The following are example of student project of garage (Fig. 4.3).

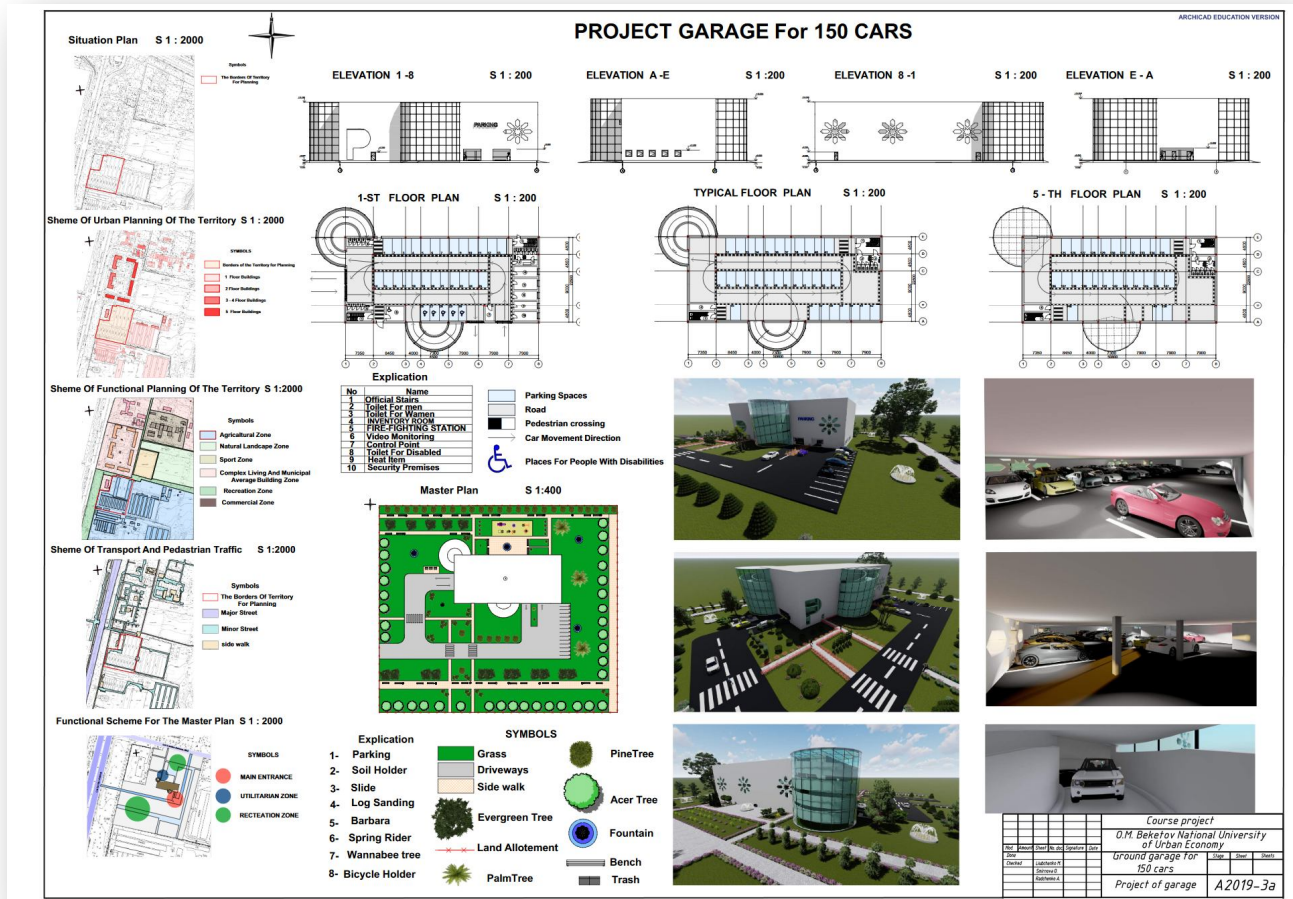


Figure 4.3 – Example of student project (Ajdid Y., gr. A 2018-4a)

After arranging all parts of the project on one sheet, it is necessary to compose separate drawings into an album (Fig. 4.4). The album consists of A3 sheets and a title page, each format, except the title page, must have a frame and a main inscription. The album contains drawings in the following sequence:

1. Situational scheme.
2. Scheme of analysis of urban planning of the territory.
3. Scheme of functional zoning of the territory.
4. Scheme of organization of transport and pedestrian traffic.
5. General plan.
6. Plans of the 1st, typical and last floors.
7. All facades.
8. Parking building visualization.
9. Visualization of the inner space of the parking.
10. A reduced copy of the entire project.



Figure 4.4 – Album of project drawings

REFERENCES

1. ДБН В.2.3-15:2007 Споруди транспорту. Автостоянки і гаражі для легкових автомобілів – [Чинний від 2010-09-01]. Вид. офіц. – Київ : Мінбуд України, 2007. – 80 с.
2. ДБН В.2.3-15:2007 Споруди транспорту. Автостоянки і гаражі для легкових автомобілів. Зміна № 1. – [Чинна від 01.08.2007]. Вид. офіц. – Київ : Міністерство регіонального розвитку, будівництва та житлово-комунального господарства України, 2018. – 3 с.
3. ДБН В.2.3-15:2007 Споруди транспорту. Автостоянки і гаражі для легкових автомобілів. Зміна № 2. – [Чинна від 01.07.2019] Вид. офіц. – Київ : Міністерство регіонального розвитку, будівництва та житлово-комунального господарства України, 2019. – 15 с.
4. ДБН Б.2.2-5:2011. Благоустрій територій. – [Чинний від 2012-09-01]. Вид. офіц. – Київ : Укрархбудінформ, 2012. – 44 с.
5. ДБН Б.2.2-12:2019. Планування та забудова територій. – [Чинний від 2019-10-01]. Вид. офіц. – Київ : Укрархбудінформ, 2019. – 177 с.
6. Shakri K. Multi storey car parking [Electronic resource] / Khairunnur Shakri, Nuur Khairuddin. – Electronic text data. – Regime of access: https://www.sefindia.org/forum/files/2194924_8_multi_storey_car_parking_159.pdf, free resource (date of the application: 12.01.2021). – Header from the screen.

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до практичної та самостійної роботи
з дисципліни

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ЛЕГКОВИХ АВТОМОБІЛІВ НА 150 МАШИНОМІСЦЬ»**

*(для іноземних студентів другого курсу
денної форми навчання першого (бакалаврського) рівня вищої освіти
спеціальності 191 – Архітектура та містобудування)*

(Англ. мовою)

Укладачі: **РАДЧЕНКО** Алла Олександрівна,
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За авторською редакцією
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