

MINISTRY OF EDUCATION AND SCIENCE of UKRAINE

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

Methodical recommendations
for conducting practical classes, implementation
calculation and graphic and independent works
on an academic discipline

“CITY PLANNING AND TRANSPORT”

*(for applicants of the first (bachelor) level of higher education of all forms of
education specialty 192 – Construction and civil engineering, educational program
“Industrial and civil construction”)*

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INTRODUCTION

The purpose of these methodological recommendations is to help students with the calculation and graphic task “General City Plan”, according to the work program for the discipline “City Planning and Transport”.

In the recommendations, the sequence of work is outlined in a concise form, formulas for the necessary calculations are given, as well as recommendations for the design of the graphic part of the work and the explanatory note.

A template for writing an explanatory note is given in the appendix A, p. 27.

The basis for the work is the design task contained on the first page after the cover of the explanatory note (appendix B, p. 28).

PURPOSE AND TASK CALCULATION AND GRAPHIC TASK

Completing calculation and graphic work contributes to the consolidation of knowledge acquired by students during the study of the course at lectures and practical classes. During the development of the work, students acquire practical skills of taking into account the factors that influence the choice of territory for the location of certain functional zones, get acquainted with the main elements of the city, rational and optimal solutions of the planning structure of the city, its zoning, etc.

CONTENTS OF CALCULATION AND GRAPHIC TASK

Calculation and graphic work consists of a graphic part and an explanatory note. The volume of the graphic part is a sheet of Whatman format A1 in Scale 1 : 10 000 (or A3 in Scale 1 : 20 000).

The explanatory note should be placed on odd-numbered pages of these methodological instructions. The basis for the work is the assignment received by the student. It consists of text and graphic parts. The textual part contains the location of the city, a list of industrial enterprises, institutions and other city-forming objects, the size of their territory, the number of employees, the percentage of the city-forming group among the total number of city residents for the first phase of construction and for the settlement period, the class of enterprises according to the sanitary classification, the number of floors of the building.

The graphic part of the task is a topographic map of the area.

WORK PERFORMANCE SEQUENCE

- a) familiarity with the textual and graphic parts of the task;
- b) analysis of the territory according to the conditions of its suitability for placement certain functional areas;
- c) determination of the size of the city territory and its main elements, calculation of the preliminary balance of the territory (table 3.3, p.13);
- d) development of sketches of the planning structure of the city (see p. 24);
- e) approval of the scheme by the teacher;
- g) design of the graphic part;
- h) calculation of the project balance of the territory;
- j) protection of the completed work.

1 OUTPUT DATA

This section provides the source data: a city in Ukraine near which a new city will be designed, its climatic characteristics, natural geographical and engineering and construction conditions, transport support (availability of railways and roads).

Using a physical-geographic zoning map of the territory of Ukraine (Fig. 1.1), it is necessary to identify the climatic zone of the site for construction future city. Applying those given in Ukrainian codes (DSTU NB V.1.1 – 27:2010)

Building climatology data, receiving information about the climate of the area: average monthly temperature, relative humidity, data on wind direction and speed.

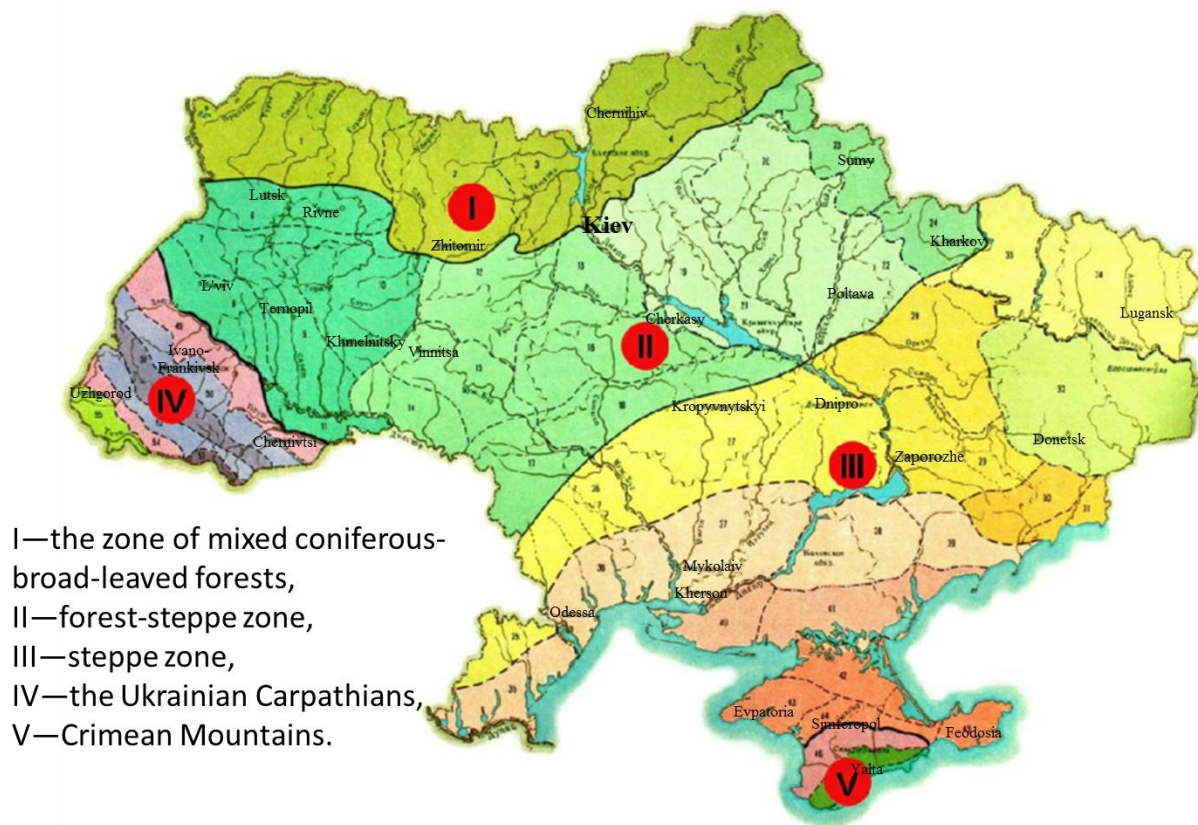


Figure 1.1 – Geographical regions of Ukraine

2 DETERMINATION OF THE NUMBER OF THE POPULATION AND THE AREA OF THE PRINCIPAL CITY TERRITORY

2.1 Determining the number of the city's population

To determine the number of the population, it is necessary: first, to calculate the number of employees at enterprises and institutions that have city-forming importance, i.e. at industrial enterprises; in institutions of external transport; in administrative, cultural, educational and scientific institutions that are important outside the city limits; in higher and secondary educational institutions.

Relying on the huge number of employees, as well as on indicators specific weight of the city-forming population group in different periods of construction, determine the number of the city's population for the first stage of construction, accounting period and perspective.

2.2 Identifying the need for residential area

According to Ukrainian cods (DBN B.2.2–12:2019 Planning and development of territories) for a preliminary determination of the need for agricultural territory is taken generalized indicators depending on the average number of floors of the building. These indicators are given in table 2.1.

Using them, as well as the percentage of city residents living in buildings of different stories in accordance with the design task, reveal the average indicator of the need for agricultural land per 1,000 residents in the planned city and the area of the agricultural territory for different periods of construction.

Table 2.1 – Specific indicators for previous determination needs of the residential territory (Ukrainian cods)

Average number of store's building	Territory, ha for 1000 people
9 and more	7
4–8	8
Up to 3 without land plots	10
Same with land plots	50

3 DETERMINATION OF NUMBER OF POPULATION AND GREEN AREAS OF MAIN TERRITORIES OF THE CITY (CALCULATIONS)

3.1 Determine the city population

The number of the city-forming population is

$$A = \underline{\hspace{10em}} = \underline{\hspace{10em}} \text{ ths. people.}$$

Number of people for the first time building

$$P_1 = \frac{A \cdot 100}{a_1} = \underline{\hspace{10em}} = \underline{\hspace{10em}} \text{ ths. people;}$$

For the billing period

$$P_b = \frac{A \cdot 100}{a_b} = \underline{\hspace{10em}} = \underline{\hspace{10em}} \text{ ths. people;}$$

$$\text{For the future} = P_f = P_b \cdot 1,2 \underline{\hspace{10em}} = \underline{\hspace{10em}} \text{ ths. people,}$$

where P_1, P_b, P_f – accordingly the number of people in 1st turn, in the accounting period and in the future;

A – the absolute number of city-forming population;

Specific index of the city-forming population:

a_1 – for the first time of building (%);

a_b – for the billing period.

3.2 Identification of the need for a local area

The average indicator of the need for a local area:

$$I = \frac{100}{\frac{K_9}{R_9} + \frac{K_{4-8}}{R_{4-8}} + \frac{K_3}{R_3} + \frac{K'_3}{R'_3}} = \underline{\hspace{10em}} = \underline{\hspace{10em}} \text{ ha /ths. people,}$$

where I – the average indicator of the need for a local area - ha / thousand people;

K_9, K_{4-8}, K_3, K'_3 – Percentage of the total living space, respectively, in 9 or more, 4-8, 3-storey houses, as well as in houses with 3 or less floors with the land plot (tasks for the design of the city p. 28);

R_9, R_{4-8}, R_3, R'_3 – Indicators of the need for a residential area with an average surface of development of 9 or more, 4-8, up to 3 floors and up to 3 floors with a plot of land (table 2.1).

Area of the territory:

first of all construction $T_1 = P_1 \cdot I$ _____ = _____ ha;

for the estimated (building) period $T_b = P_b \cdot I$ _____ = _____ ha;

for the future $T_f = P_f \cdot I$ _____ = _____ ha,

where – T_1, T_b, T_f the area of the local area of land for the first time, the construction period, the estimated (building) period and the prospect, ha;

P_1, P_b, P_f – the population in the relevant periods, thousand people.

3.3 Calculation of the area of the City center (Down town)

The area of the territory on which the city center should be located, calculate based on the specific indicator of the needs of the territory for the city center (Down town), which is $S_{DT} = 7 - 10 \text{ m}^2 / \text{person}$ and a promising population.

3.4 Determination of the area of green areas of residential areas

The area of green areas of residential areas should be determined in accordance with Ukrainian cods Б.2.2-12:2019 (table 3.1).

Table 3.1 – Areas of greened territories

Landscaped public areas within the town	Groups of cities by quantity people, thousands of people	Area of green areas, $\text{m}^2 / \text{person}$.			
		I, II – the zones of mixed coniferous-broad-leaved forests	III – forest-steppe zone	Steppe IV – steppe zone	IV – the Ukrainian Carpathians; V – Crimean Mountains
Citywide	50–250	7	8	9	11
Residential areas	50–250	6	6	7	8

Notes. In the towns where the industrial enterprises of the I and II class are located, the norms of the city-wide greened areas of general use should be increased by 15–20 %. In towns where railways are located, the norms of person greened areas of general use should be increased by 5–10 %.

3.5 Determination of the area of individual elements of the residential territory

The area of the site of the medical center is $S_{mc} = 0,1 \text{ ha}$ per 1,000 inhabitants of the city, based on the prospective population. For the location of the medical center is distinguished from the best point of view microclimate of the site, within walking distance of city bus stops transport to accommodate a city sports complex with a stadium an area of 10–13 hectares is allocated.

The area of S_m the medical center is:

$$S_m = P_f \cdot S_{mc} = \text{_____} = \text{_____} \text{ ha,}$$

where S_{mc} – the specific indicator of the need for the territory to accommodate the medical center, 1 ha for 1 000 people (m^2 / ha).

The town sports complex with a stadium occupies a plot of _____ (10–13 ha).

3.6 Determination of the area of landscape and recreational territories

The green areas of the city use:

$$S_{lra} = \text{_____} \text{ ths.m}^2 = \text{_____} \text{ ha,}$$

where S_{lra} – the specific indicator of the need for greenery areas of urban use (Residential areas), $\text{m}^2 / \text{person}$, according to table 3.1 of the guidelines.

3.7 Formation and location of industrial districts

At the next stage of designing from the enterprises of the title list, that is in the design task, industrial districts should be formed as such so that the number of employees in each does not exceed 30,000 man, and the area of the territory was not more than 300 hectares.

Before starting the development of the scheme, it is necessary to define the structure industrial districts. According to the conditions of the location of industrial districts in the city is divided into three urban planning categories.

Enterprises that make up the first industrial district urban planning category, placed at a distance from rural areas territories according to the requirements of sanitary and fire regulations. These enterprises produce harmful industrial waste (I and II class of sanitary classification), have a significant cargo turnover (more than 40,000 tons per year), need railway transport, and are also characterized by special conditions production (fire and explosive, radioactive, chemically harmful).

The second urban planning category consists of industrial districts, which mostly contain III-class enterprises, but there may be IV and V class enterprises. These enterprises do not emit a significant amount of harmful substances, but need railway access tracks. This industrial area can be located on the border with the agricultural territory and separate from of residential buildings only as a sanitary and protective zone.

Enterprises that do not need railroad access tracks do not emit harmful substances, do not create abnormal noise, belong to the IV or V class, it is advisable to place them within the boundaries of the farm territory in this case, the role of the sanitary protection zone (50–100 m) greened highway or pre-plant territory is performed.

Table 3.2 – Distribution of industrial enterprises to industrial areas of different urban areas

Number	Name of Enterprises	Number of employees, thousand people.	The size of the industrial site,	Annual cargo turnover, ths. tons.	Class of harm
<i>1 industrial district</i>					
<i>The first city planning category*</i>					
<i>The second city planning category</i>					
<i>Enterprises that need a railway**</i>					
<i>Enterprises that do not need a railway***</i>					
<i>2 industrial district****</i>					
<i>The third city planning category</i>					

* Heavy industry enterprises with harm class I – II.

** Enterprises that do not need a railway with harm class – III.

*** Enterprises that do not need a railway with an annual cargo turnover of less than 40 ths. t / year.

**** Industry enterprises with harm class IV.

3.8 Definition of the area of production areas

Placement of production areas is not allowed:

- in the first and second zones of the zone of sanitary protection of sources water supply;
- within the coastal protective strips of rivers and reservoirs;
- on lands for recreational and health purposes; on lands nature reserve and other nature protection purposes;
- in the zones of active karst, landslides, subsidence or collapse of the surface under by the influence of mining, mudflows and snow avalanches, which can threaten the construction and operation of enterprises;
- on sites contaminated with organic and radioactive waste;
- in areas of possible catastrophic flooding, etc.

The production area is divided into zones according to their function destination. The production territory includes: industrial, utility and warehouse, scientific, scientific and industrial zones, as well as the zone external transport and the block of engineering support of the city.

Plots of enterprises included in the industrial district, make up 50–60 % of the entire territory. The rest is used for accommodation warehouse and energy facilities (5–8 %), transport communications and structures: access railway tracks, automobile streets and roads, motor transport enterprises, workshops, sorting stations, depots etc. (5–7 %); cultural and household and scientific and technical centers (2–5 %); green areas (10–12 %) and as a reserve area (10–20 %).

The area of the plot for the placement of the communal and warehouse area should be taken from calculation $S_{CW} = 2,5 \text{ m}^2/\text{person}$, based on the prospective number population of the city. The final determination of the area of the production area is possible to do after placing its elements on the territory and identifying the area which occupy sanitary protection zones.

To reduce the harmful effects of industrial areas, transport, warehouse zones to residential areas of the city between they arrange sanitary and protective zones greened strips in width in accordance:

I class – 1,000 m, II class – 500 m, III class – 300 m, IV class – 100 m, V class – 50 m.

3.9 Definition of the area of production areas (calculations)

For the preliminary determination of the size of the production area on the first turn and the calculation period, use the formula

1 industrial district (table 3.2, p. 12):

$$S_{PA} = \frac{S_{enterprises}}{0,6} = \frac{\quad}{0,6} = \quad \text{ha,}$$

where S_{PA} – area of the production area, ha;

$S_{enterprises}$ – the total area of the enterprises of the town-forming group according to the task, ha. The size of the production area for the future:

$$S_{PA}^F = S_{PA} \cdot 1,2 = \quad \text{ha,}$$

where 1,2 – coefficient, considering the expansion of the territory in the future.

2 industrial district (table 3.2, p. 12):

$$S_{PA} = \frac{S_{enterprises}}{0,6} = \frac{\quad}{0,6} = \quad \text{ha,}$$

where S_{PA} – area of the production area, ha;

$S_{enterprises}$ – the total area of the enterprises of the town-forming group according to the task, ha. The size of the production area for the future:

$$S_{PA}^F = S_{PA} \cdot 1,2 = \quad \text{ha,}$$

where 1,2 – coefficient, considering the expansion of the territory in the future.

The area of the communal warehouse area within the production area:

$$S_{CW}^P = S_{iw} \cdot P_f = \quad \text{ths.m}^2 = \quad \text{ha,}$$

where S_{iw} – the specific indicator of the needs of the territory for the placement of communal and warehouse area 2,5 m²/person.

The size of the communal warehouse area in perspective:

$$S_{CW}^F = S_{CW} \cdot 1,2 = \quad \text{ha.}$$

3.10 Determination of the estimated area of the city territory

Based on the calculations, a preliminary balance is drawn up and the estimated area of the city territory is determined, the latter is the sum of the areas of its main territories – residential, landscape-recreational and industrial, see table 3.3.

Table 3.3 – Preliminary balance of the territory

Number	Territory	Indicators, ha		
		for the 1-st stage of construction	for the estimated (building) period of construction	for the perspective (future) of construction
A. RESIDENTIAL AREAS				
1	Micro districts, streets, roads, and other functional areas			
2	City center (Downtown)			
3	Green areas			
4	Site of the medical center			
5	Sports complex			
	TOTAL under section A	T₁=	T_b=	T_f=
B. PRODUCTION TERRITORIES				
6	Industrial enterprises			
7	Communal and warehouse			
8	Other territories			
	TOTAL under section B			
C. LANDSCAPE AND RECREATIONAL TERRITORIES				
9	Green areas			
10	Water spaces within the city			
11	The plots are not suitable for construction			
	TOTAL under section C			
	TOTAL			

4 PLANNING DECISION

4.1 Scheme of the planning structure of the city

This stage of work should determine the mutual location of the main territories and functional zones. On the scheme, their boundaries are determined in accordance with the calculations made and the previous balance of the territory and the distance between them, in accordance with sanitary standards. Determine the form of the plan (compact, fragmented or decentralized). When further designing the limits of these territories will be specified, but the planning structure of the city must be preserved.

This section of the explanatory note contains a description and justification of the adopted planning decisions, a scheme of the planning structure and transport services of the city.

Taking into account the planning restrictions, the direction of the wind, the direction of the river, the location of the railway, it is necessary to place the formed industrial districts on the territory designated for the city.

The planning structure of the city largely depends on the location of the industrial district of the first urban planning category, because it is in this district that a significant number of the city-forming population group works.

In addition to the specified requirements, the industrial area of the first urban planning category must be located in relation to the prevailing winds on the leeward side of the residential area and downstream of the river. In addition, the relief of the site should be calm, with slopes not exceeding 3–5 %. Approach railway tracks should be brought to the territory of enterprises so that they do not cross city transport networks.

The industrial area must have a reliable transport connection with the residential area. In the event that the number of employees exceeds 30,000 people, main streets must approach the industrial district from at least two opposite sides of the residential area for the purpose of rational use of urban transport.

4.2 Graphical scheme of the planning structure of the city

Taking into account the preliminary analysis of the natural-climatic and anthropogenic resources of the territory, it is proposed to design the city _____ with the form of a plan consisting of districts located _____.

The following factors were taken into account when forming industrial districts of various categories _____ which led to the formation of _____ industrial districts, which are proposed to be located _____.

The boundaries of industrial districts must be established taking into account the fact that the area of industrial enterprises is only 60% of industrial territories, and we separate it from agricultural territory by sanitary protection zones.

4.3 Determining the boundaries of the residential territory

After placing the first industrial district and its sanitary protection zone, the border of the residential area should be determined. The size of this of the territory was obtained in the calculation part of the project. When placed residential areas, planning restrictions must be taken into account, established as a result of the analysis of the suitability of the territory for construction cities The territory with slopes of 10–20 % can be allocated under low-rise buildings, the district of which according to the task should be in each the projected city.

After placing the first industrial district and its sanitary protection zone, the border of the residential area should be determined. The size of this territory was revealed in the calculation part of the project. When placing residential areas, it is necessary to take into account the planning restrictions established as a result of the analysis of the suitability of the territory for city construction.

The mutual location of production and residential territories is important. The latter protect against the effects of harmful gases, smoke, and dust emitted by industrial enterprises. This especially applies to the industrial district of the first urban planning category, as it contains enterprises of the I and II classes of harmfulness according to the sanitary classification.

When determining the boundary of the residential territory, one should strive for maximum compactness. Thus, on the side of the production territory, the boundary of the residential territory is a sanitary and protective zone; it is separated from the railway track by a 100 m wide diversion strip, from a river or reservoir – an area that can be flooded during a flood.

A highway system is being designed within the residential area district importance and residential streets. These streets are the boundaries of neighborhoods, into which residential areas are usually divided. At the same time, streets with public transport do not cross the territory of micro districts.

The number of micro districts depends on the size and local conditions residential area. The population of the micro district is determined by the accepted number of floors of residential buildings, walking distance to service institutions and is approximately 6–12 thousand people, and the size of the territory is 20–30 hectares.

The city center is located near the geometric center of the city, on elevated terrain. If there is a reservoir, the city center can be shifted towards it.

In addition to the city-wide center, peripheral district centers are formed in the city, which include administrative-management and cultural institutions for the service of district residents. The service radius of centers in residential areas is 1,500 m.

According to DBN B.2.2–12:2019, the area of plots of the centers of peripheral planning districts and centers of residential districts is taken within the limits of $S_{CRD}^E = 3,5–5,6 \text{ m}^2/\text{person}$, based on the population of the district.

Fire stations are located throughout the city, their radius of maintenance should not be more than 3 km, and the area of each plot should be 0,9–1,75 ha.

On the scheme of the planning structure of the city, the boundaries and numbers of residential areas, the area of their territory and the number of residents living in this area are indicated; boundaries of industrial districts, the total area of their territory and the number of employees; classes of harmfulness of enterprises included in the industrial district.

On the master plan of the city, the territories for the first phase of construction, the calculation period and the perspective should be allocated. The area of the first stage of construction is an independent functional element. Therefore, the territory of the first stage of construction should be located near industrial enterprises and be as compact as possible. The first stage of construction includes the city center.

4.4 Determining the boundaries and planning of the residential area (calculations)

The residential area of the city consists of _____ planning districts located _____ their area is ____ ha, and the population, respectively:

$$P_{1d} = \frac{S_{1d}}{I} = \text{_____} = \text{_____} \text{ ths. people;}$$

$$P_{2d} = \frac{S_{2d}}{I} = \text{_____} = \text{_____} \text{ ths. people;}$$

$$P_{3d} = \frac{S_{3d}}{I} = \text{_____} = \text{_____} \text{ ths. people;}$$

where P_{1d}, P_{2d}, P_{3d} – population of the district, thousands of people;

S_{1d}, S_{2d}, S_{3d} – the absolute number of city-forming population;

I - the average indicator of the need for a local area – ha/thousand people (p. 7).

There are district boundaries _____

Downtown located _____

their area is ____ ha.

In the peripheral areas there are district centers (S_{2cd}), the area of which is

$$S_{2cd} = \frac{P_{2d}}{S_{CRD}^E} = \text{_____} = \text{_____} \text{ ths. people;}$$

$$S_{3cd} = \frac{P_{3d}}{IS_{CRD}^E} = \text{_____} = \text{_____} \text{ ths. people.}$$

where $S_{2rd}; S_{3rd}$ – area of residential district;

S_{CRD}^E – specific indicator of need in the territory (p. 15);

Centers of residential areas are located _____

The site of the medical center is planned to be located _____

because this is the most favorable territory from the point of view of microclimate.

The city sports complex is located _____. The area of its plot is ____ ha. The project provides accommodation _____ fire stations within the city.

4.5 Placement of the utility and storage area and external transport zones

After the preliminary determination of the border of the residential territory, it is necessary to return to the formation of production territories, where, in addition to industrial districts, a communal storage zone and an external transport zone should be located.

Within the territory of the city, only warehouse complexes connected with direct service to the population are located: enterprises and objects of the food industry, trade and fruit and vegetable farming; distribution refrigerators, fruit and vegetable bases; storage of vegetables and fruits, other consumer goods.

Utility and storage areas should not be located on the territory industrial nodes, which include enterprises of classes I-III according to the sanitary characteristics of production and their sanitary protection zones. The utility-storage zone can be located along the railway and external highway. It will be separated from the agricultural territory by sanitary and protective zones. The width of the sanitary protection zones between warehouse areas and residential areas depends on the type of warehouses and ranges from 50 m for communal warehouses to 500 m for others.

For the maintenance of passenger and cargo transportation, as well as rolling stock within the city and the surrounding area, areas for facilities and devices of various types of interurban transport are provided. Sorting and loading facilities are provided in the production areas stations and freight yards. They should be located on the outskirts of the city and on connecting branches serving a number of industrial enterprises. Sorting stations are located in areas of mass loading and unloading of railway cars.

For railway stations, horizontal and straight sections with a slope of no more than 1,5% should be provided, and in difficult conditions – up to 2,5 %. Stripping lanes for the placement of vehicles (see Fig. 4.1).

A sanitary protection zone should be provided between the railway and residential buildings, the width of which, counting from the axis of the extreme railway track to the buildings, should be at least 100 m, and when the railway is located in a recess and when special noise protection measures are implemented, at a distance of at least 50 m, more than 50 % of the area of the sanitary protection zone must be landscaped. Its width to the borders of the plots of garden and cottage buildings is necessary take at least 50 m.

Railway stations within settlements should be placed on boundaries of central and peripheral zones near residential and public areas buildings with provision of convenient transport links with the center settlement, its main residential and industrial areas, stations of other types of transport.

4.6 Placement of communal and warehouse area and zone external transport

The communal and warehouse area, the area of which was calculated earlier, is located _____
 _____ The external transport zone
 in the planned city includes _____
 _____ Of them, the production areas are located
 _____ occupying an area _____ ha,
 and on the residential area – _____
 _____ which makes up the area _____ ha.
 The railway station is located _____
 _____. The central bus station is located
 _____. Its area is _____ ha.
 In addition, a bus station is planned in the city. Its area is _____ ha, it is located
 _____.

In larges towns and in cities it is necessary to provide placement of one central bus station for long-distance communication on which 3–4 ha and several (from one to three) suburban passenger bus stations with sites of 0,5–1 ha under each of located in the middle or peripheral part of the city on exits of highways outside the city.

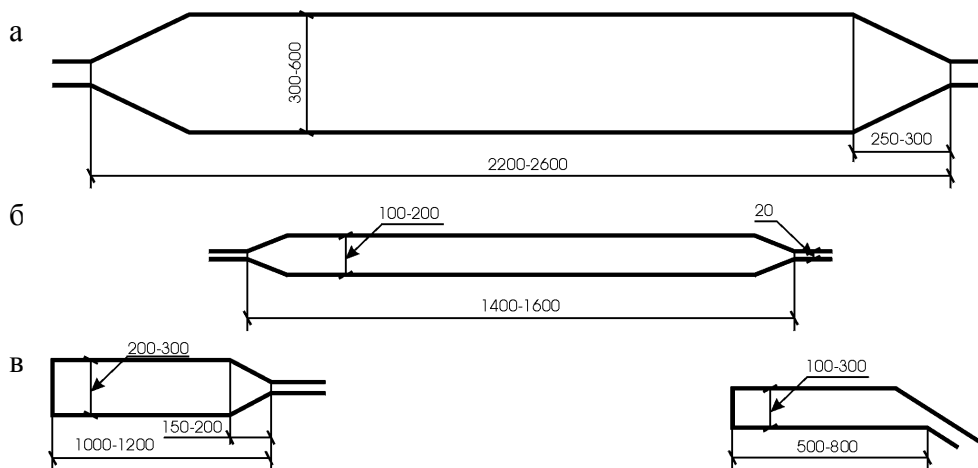


Figure 4.1 – Diversion lanes for the placement of railway vehicles (the sizes in m):
 a – marshalling yard station; b – passenger passing station; c – passenger
 deadlock station; d – goods terminal

Distance from bus stations to residential buildings should be at least 100 m, and from bus stations – 50 m respectively, and be separated from this development by green protective zones with a width of at least 20 m.

4.7 Scheme of transport service

The network of streets and roads is formed in the form of a single system, its structure depends on the size of the territory and the mutual location of the main elements of the city. Main streets and roads connect the main functional zones and elements of the city into a single organism. At the beginning of the design, the places of greatest attraction of the population should be identified and connected with main streets of city-wide importance. Main streets are provided in the directions of the main passenger flows, on the connections of residential areas with the city center and large industrial enterprises. The shortest and straightest section of the main street of city-wide importance should connect the city center with the passenger railway station. The distance between main streets should be determined within 800–1000 m, that is, their pedestrian accessibility for residents of the most distant building should not exceed 500 m.

When laying out highways, relief forms, requirements for slopes, which should be within 0,4–6,0 %, should be taken into account to ensure traffic safety and drainage. The most economical is the laying of highways along Thales or watersheds. It is necessary to avoid tracing main streets parallel to the prevailing wind direction if its speed exceeds 3,5 m/sec. This especially applies to the direction of the winds in the winter period. At least two highway exits from the city should be provided for communication with other settlements.

The main transport and composition nodes of the city are squares according to their functional purpose, they are divided into central, station, market, transport, and pre-factory. Squares are designed on a calm terrain with a slope of 1,0–3,0 %. Their configuration should be as simple as possible. In the case of a rectangular shape, the ratio of width and length is from 1:3 to 1:1.

The project should provide for a station square with dimensions of 0,5–1,5 ha. Transport networks pass along the periphery of the station square. At the intersection of transport networks, cities form transport squares, and in the city center - the main square of the city.

4.8 Planning organization of sanitary protection zones

The territory of the sanitary protection zones is divided into three main parts: pre-industrial protective greening (13–56 % of the total area of the sanitary protection zone); residential protective greening (17–58 %) of planning use, where sections of the transport industry can be located; bus and trolleybus parks with workshops – 4,0–5,0 hectares; taxi fleet, service stations – 0,3–2,5 hectares, as well as garages for trucks and cars, parking lots for private vehicles, etc.

4.10 Placement of utility facilities and engineering infrastructure facilities

The city's engineering equipment must provide the necessary conditions for the operation of enterprises and the life of the city's population. It includes: water supply system, sewage system, electricity, heat and gas supply. The system of buildings and engineering communications of a modern city requires the allocation of special areas both within the city limits and outside them.

Water intakes from surface sources of domestic and drinking water pipes should be located in areas that ensure the organization of sanitary protection zones, above sewage discharges of settlements, as well as ship parking lots, forest exchanges, commodity transport bases and warehouses.

Water intakes from surface sources of economic and drinking water pipelines should be placed above settlements, in areas where the organization of sanitary protection zones is ensured. The catchment area is 3,0–5,0 hectares per city. A sanitary protection zone is provided for 200 m upstream from water intakes; 100 m – downstream; towards the shore adjacent to the water intake – 100 m.

4.11 Planning organization of sanitary protection zones

It is planned to place in the areas of planned use in sanitary zones

_____. total area
_____ ha. The rest of the square is a green area.

Water intakes are located in the planned city _____

Plot sizes _____ ha, sanitary protection zones _____. Wastewater treatment facilities are located _____. Plot sizes _____ ha, sanitary protection zones _____. The city is supplied with energy from the networks of the district energy system through step-down substations. They are located _____, plot sizes _____ ha. Thermal power plants are located _____, plot sizes _____ ha. In a separate residential area, the construction of a district heating boiler house, which is located, is planned _____ plot sizes _____ ha. Gas filling stations are located _____, plot sizes _____ ha. In the suburban zone, a plot for a cemetery is allocated, its territory is _____ ha. It is located _____
_____.

Treatment plants are placed outside the city limits downstream of the river, or in land thalwegs. Plot sizes are 6,0–20,0 hectares per city. Sanitary protection zones for city sewage treatment facilities are designed with a width of 300–500 m.

The energy supply of the cities is provided by the networks of the district energy system. The size of the sites for step-down substations is 0,6–1,5 ha and placed at a distance of at least 25 m from residential buildings.

Thermal power plants (CHPs) should be located outside the rural area with a minimum length of main heat routes from the centers of heat loads. The size of the site for placing the CHPs is 4,0–6,0 hectares.

The size of gas filling station sites (GFS) is 6,0–8,0 ha, and their distance from facilities of various purposes is 100–150 m.

In the suburban zone, a plot of land for a cemetery is allocated at the rate of 0,1 ha per 1,000 inhabitants of the city. This plot should be located at a distance of at least 500 m from residential areas.

Household waste sorting and disposal facilities are allowed to be located in industrial and communal storage areas of settlements and outside them, or on the territory of a solid household waste landfill, the land plot is selected taking into account the possibility of connecting the facility to engineering networks.

Location of facilities for sorting and disposal of household waste in recreational areas, sanitary protection zones of water supply sources and coastal strips of water bodies, protection zones of resorts is prohibited.

4.12 Formation of landscape and recreational areas

The composition of green areas of general city use should include a city park with an area of 100 hectares, located next to the city center. The rest of the area should be used for district and specialized parks: children's, sports, botanical, etc. The existing massifs of the surrounding forests are being transformed into urban forest parks. Along with the centers of peripheral districts, they form district parks, the area of which is specified according to the data in table 3.1, p. 7.

4.13 Formation of landscape and recreational areas (calculations)

The project envisages the formation of a continuous system green areas. As part of the territories of citywide use include a city park with an area of:

$$S_{lac} = \text{_____} \text{ ths.m}^2 = \text{_____} \text{ ha}$$

where S_{lac} – the specific indicator of the need for greenery areas of urban use (Citywide), m^2 / person, according to table 3.1 of the guidelines.

The existing massifs of green spaces have been transformed into urban forest parks, the area of which is _____ ha.

The area of green areas of residential districts are:

$$S_{1gd} = P_{1d} \cdot S_{ga}^P = \text{_____} = \text{_____} \text{ ths. m}^2 \text{_____} \text{ ha};$$

$$S_{2gd} = P_{2d} \cdot S_{ga}^P = \text{_____} = \text{_____} \text{ ths. m}^2 \text{_____} \text{ ha};$$

$$S_{3gd} = P_{3d} \cdot S_{ga}^P = \text{_____} = \text{_____} \text{ ths. m}^2 \text{_____} \text{ ha}.$$

where P_{1d}, P_{2d}, P_{3d} – population of the district, thousands of people;

$S_{1gd}, S_{2gd}, S_{3gd}$, – the area of green areas of the respective residential areas districts;

S_{ga}^P – specific index of greening of residential areas according to the table 3.1, p. 7 _____ m^2 / person.

In the directions of pedestrian traffic along highways, boulevards, squares, and pedestrian alleys are planned.

Nurseries of trees, shrubs and flower greenhouses are located _____ their total area is 80 ha.

Table 4.1 – Projects balance of the territory

Number	Territory	Indicators according to the master plan		
		ha	%	m ² /per
A. RESIDENTIAL AREAS				
1	Residential areas			
2	Area of the city center			
3	Center of the 2nd district. Center of the 3rd district			
5	Medical center			
6	Sports facilities			
7	Green areas within residential areas			
8	Streets, roads, squares, car parks			
9	Industrial enterprises			
10	External transport			
11	Other territories			
TOTAL under section A				
B. PRODUCTION TERRITORIES				
12	Industrial enterprises			
13	Communal and warehouse area			
14	External transport zones			
15	Streets and roads of industrial			
16	Sanitary and protective zones			
17	Other territories			
TOTAL under section B				
C. LANDSCAPE AND RECREATIONAL TERRITORIES				
18	Green areas for common use			
19	Water bodies			
20	Recreation areas			
21	Other territories			
TOTAL under section C				
TOTAL ACCORDING TO THE MASTER PLAN				

5 CONTENTS OF THE GRAPHIC PART

After the supervisor approves the sketch of the master plan, the student prepares the graphic part of the work. A rose of winds, a general plan of the city on a scale of 1:10 000, transverse profiles of streets and roads, an explanation, notations, and a project balance of the territory are placed on it. It differs from the previous balance in that it is calculated based on the measured drawings of the master plan.

Based on the results of these measurements, as well as on preliminary calculations, technical and economic indicators are determined. Residential buildings of the first stage of construction, the calculation period and for the future are distinguished by tone intensity. A sample layout of the diagram of the graphic part is provided in Figure 5.1.

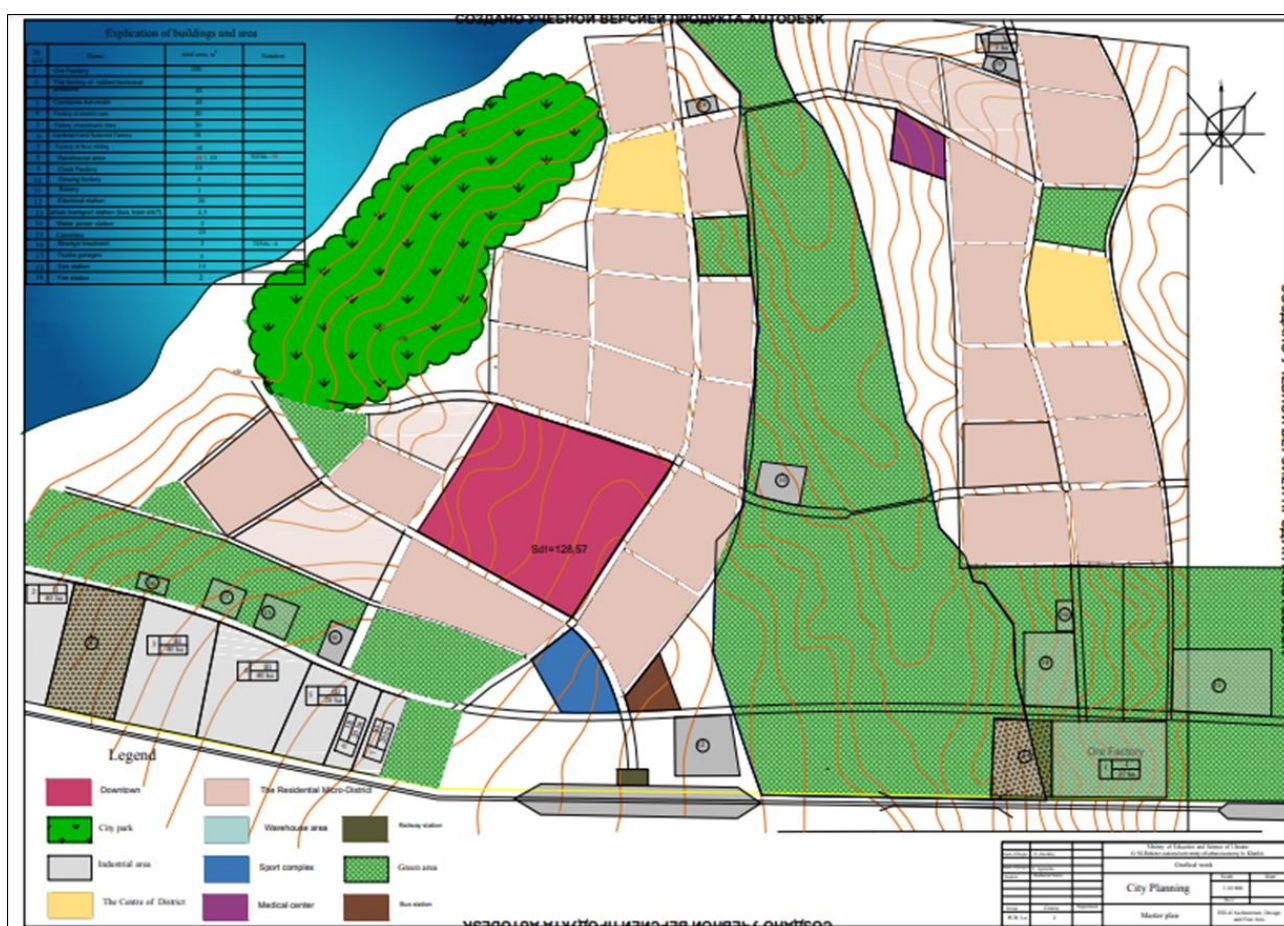


Figure 5.1 – An example of a master plan

TECHNICAL AND ECONOMIC INDICATORS

1. Population of city:
for the first time building _____ ths. people.
for the billing period _____ ths. people.
for the perspective _____ ths. people.
2. Total area of the city _____ ha.
3. Indicator of the need for residential area for 1 000 inhabitants
_____ ha/th. people.
4. Density of population * _____ people /ha.
5. The length of the street network _____ km;
including highways _____ km.
6. The density of the trunk network ** _____ km /km².

* Population density - the number of people per 1 ha of the city's territory.

** The density of the highway network is the length of the highways, which is related to 1,0 km² city territory (within the city limits).

RECOMMENDED LITERATURE

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APPENDIX A
Cover letter for calculation and graphic work

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

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

Department of Urban Construction

**EXPLANATORY NOTES
to the graphic works**

CITY MASTER PLAN FOR _____ THOUSAND RESIDENTS

Ph.D of Technical Sciences, Professor, Head of the
Department of Urban Construction O. V. Zavalnyi

Head _____

Student _____

_____ course, _____ group

Kharkiv – O. M. Beketov NUUE – 2023

APPENDIX B

Form for performing calculation and graphic work TASKS FOR THE DESIGN OF THE CITY

Student _____ course _____ group _____

1. Topographic scheme – options..... _____
2. The economic importance of the city – industrial center..... _____
3. Building area – _____
4. Industrial enterprises are city-forming significance – _____ option.

Number	Name of Enterprises	Number of employees, thousand people.	The size of the industrial site, ha	Annual cargo turnover, ths. tons	Class of harm
TOTAL				–	–

5. Number of employees working at other enterprises and institutions of town-forming value (ths. people):

Railway	1,2
Motor transport	1,0
Administrative and economic institutions of foreign significance	0,4
Secondary schools	0,6
Construction organizations	0,8

6. Share of city-forming population (%):

For the first of all building – a_1	43
For the billing period – a_b	38

7. Distribution of housing stock by stores:

9 or more floors	K_9	
4-8 floors	K_{4-8}	
to 3 floors without land plots	K_3	
up to 3 floors with plots of land	K'_3	

8. Flood water rise (m) 1, 50

Task issued _____ Project Manager: _____

APPENDIX C
Tables for performing calculation and graphic work

Table C.1 – Cities of Ukraine

Number	The name of the town	No. option	The name of the town
1	Kiev	15	Sumy
2	Chernigov	16	Krapivnitzkiy
3	Zhytomyr	17	Kharkov
4	Rivne	18	Lugansk
5	Lutsk	19	Donetsk
6	Lvov	20	Dnepr
7	Ternopol	21	Zaporozhe
8	Ivano-Frankivsk	22	Nikolayev
9	Khmelnitsky	23	Kherson
10	Chernovtsy	24	Odessa
11	Uzhhorod	25	Simferopol
12	Vinnitsa	26	Evpatoria
13	Cherkasy	27	Feodosiya
14	Poltava	28	Yalta

Table C.2 – Composition of enterprises forming a group in a town that is projected

Number	Enterprises numbers	Number	Enterprises numbers
1	11, 12, 20, 25, 27, 28, 35, 39	16	5, 10, 14, 26, 27, 30, 39, 40, 41
2	3, 4, 13, 14, 19, 33, 34, 35, 41	17	6, 9, 21, 24, 28, 31, 25, 34, 40
3	6, 8, 9, 18, 21, 23, 28, 39, 41	18	8, 9, 16, 29, 32, 24, 37, 40, 41
4	1, 8, 10, 11, 17, 19, 25, 41, 42	19	7, 10, 16, 23, 30, 33, 36, 37, 43
5	12, 13, 20, 23, 27, 38, 39, 43	20	2, 12, 16, 17, 22, 31, 38, 40, 41
6	2, 7, 13, 19, 20, 30, 38, 40, 43	21	8, 11, 15, 18, 21, 32, 40, 39, 43
7	4, 12, 15, 18, 19, 22, 33, 36, 41, 42	22	10, 12, 15, 19, 20, 24, 33, 41, 42
8	3, 8, 9, 21, 22, 32, 34, 35, 39	23	9, 12, 17, 25, 33, 35, 40, 41
9	11, 12, 22, 23, 28, 33, 39, 41, 43	24	12, 15, 16, 18, 21, 26, 31, 39, 43
10	1, 8, 13, 23, 24, 32, 36, 37, 40	25	13, 15, 19, 27, 30, 36, 37, 39, 40
11	9, 14, 21, 27, 25, 31, 37, 38, 42	26	9, 13, 20, 28, 31, 33, 38, 40, 43
12	2, 5, 11, 26, 28, 30, 39, 41, 43	27	11, 14, 21, 29, 27, 31, 37, 40, 43
13	6, 9, 16, 20, 24, 27, 29, 35, 36, 42	28	12, 15, 22, 28, 30, 36, 37, 39, 43
14	4, 8, 9, 15, 25, 28, 29, 40, 41	29	11, 13, 23, 29, 31, 34, 37, 39, 43
15	5, 10, 11, 26, 27, 29, 31, 40, 41	30	15, 16, 18, 24, 23, 32, 40, 41, 43

Table C.3 – List of industrial enterprises of the city-forming group

Number	Enterprises numbers	Number of employees, thousand people	The size of the industrial area, ha	Annual cargo turnover thousand tons	Class of harm
1	Steel rolling mill	10	100	2 500	I
2	Potash plant	6	90	290	
3	Chemical Combine	8	150	2 300	
4	Ore Factory	2	37	240	
5	Casting plant	10	100	1 600	
6	Pulp and paper mill	5	180	120	
7	Metallurgical Plant	10	80	750	II
8	Soda Plant	3	60	35	
9	Factory of synthetic fibers	7	75	50	
10	Paint and varnish plant	3	60	600	
11	Viscose silk factory	5	55	43	
12	The factory of rubber-technical products	7	40	150	
13	Turbine plant	6	45	39	
14	Cardboard and Ruberoid Factory	2	10	250	
15	Factory of technical glass	7	40	420	
16	Leather combine	3	3	22	
17	Plant of loading and transport equipment	3	25	40	III
18	Factory of electric cars	6	40	80	
19	Factory of automatic lines	4	20	60	
20	Instrument-making plant	5	15	20	
21	Factory of automobile devices	8	25	38	
22	Combines harvester	8	40	40	III
23	Tractor Engines Plant	4	15	170	
24	Excavator factory	7	60	40	
25	Refrigerator factory	5	30	180	
26	Furniture factory	1,5	20	32	
27	House-building factory	2	80	7	
28	Factory of reinforced concrete products	1	12	70	
29	Ceramic Factory	3	30	45	
30	Spinning factory	3	16	6	
31	Factory of silk fabrics	5	40	75	
32	Factory of flour-milling	0,5	10	60	
33	Meat-processing plant	1,5	10	5	
34	Knitwear Factory	3	5	14	IV
35	Gloves factory	2,5	3	4	
36	Sewing factory	1,5	4	5	
37	Confectionery Factory	1,5	6	-	
38	Tobacco Factory	1,0	9	-	
39	Cannery	1,0	9		
40	Stationery factory	4	5	10	
41	Clock Factory	5	10	15	
42	Bakery	0,5	3		V
43.	Dairy Plant	0,5	8		

Електронне навчальне видання

Методичні рекомендації
до проведення практичних занять, виконання
розрахунково-графічної та самостійної робіт
з навчальної дисципліни

«ПЛАНУВАННЯ МІСТ І ТРАНСПОРТ»

*(для здобувачів першого (бакалаврського) рівня вищої освіти
спеціальності 192 – Будівництво та цивільна інженерія,
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