

## Labor skeleton frame as functional and spatial system of city planning and management

*Daria Svoboda*

Kyiv National University of Construction and Architecture  
Povitroflotskyy prosp., 31, Kyiv, Ukraine, 03680, e-mail: hetri@rambler.ru

**Summary.** Models of work localization places originated in ancient towns and cities of the Renaissance period. Regularities of geometrical dependences are traced in many theories of the cities. An important criterion for the quality of the city planning structure is travel time-weighted average to the main places of work.

**Key words:** the labor skeleton frame forms, localization of places of work, labor links of the city, system of labor links.

### INTRODUCTION

It's not possible for researchers of city-planning theories to find the single universal decision how to denote all existing city-planning problems neglecting specific conditions of the country, its history and natural features. At the beginning of 21 century we see historically developed system of urban environment. The city is not only roads, buildings, greenery planting. It is first of all adaptive visual and time criterion of a city development.

- the visual criterion is characterized by modern perception of reality;
- the time criterion is characterized by feeling of lost time and space.

City environment, image and entity are created on the basis of natural and social requirements. From the point of view of an urbanization, the city has its social, spatial and functional structures. The city is formed by its inhabitants, striving to satisfy the requirements in the best way.

### PURPOSE OF WORK

Work on the problems of labor support (Labor resources) in the district planning is mainly based on the materials and conclusions collected, processed and formulated by planning and project organizations. Thus, the main objective has always been to reach optimal proportions in the allocation of production facilities and population.

### WAYS TO REVEAL THE PRINCIPLES FUNDAMENTAL FOR SPATIAL IN- TERACTIONS BETWEEN CITIES

Since ancient times city development has been a conscious process, conducted in accordance with the particular needs of the residents. It can be assumed that at the very early stages of city development, people created an idea about the most convenient location, major communications layout, location of temples, palaces and other buildings. These principles were gradually implemented and put to test, and can be fairly referred as to primary city development theories. The main points of ideal utopias of the past are characterized by the desire for simplicity, convenience, "availability" of a city for its residents in different variable formations. Architects and researchers sought to create new ideas of city-planning systems. The ideas and developments in ideal city creation were later transformed into utopian

theories of cities. The main idea at that time was in the definition of the division of labor of city dwellers. Ways to reveal the principles fundamental for spatial interactions between cities (movement of people, goods, information, diffusion of innovations, other relationships), led to the idea to use fundamental law of gravity, according to which any two bodies in the universe attract each other with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them, where population is taken as a mass. The city has to carry out a leading comprehensive social and economic role within the controlled area. There is a variety of different characteristics, one of which is apparently inherent in the whole settlement system as a whole, and the other will characterize individual settlements. The population of the city has functional role which is characterized, in particular by its activity (work), life, and rest. It forms a vector of land use which is differentiated according to functional grounds: residential areas, production areas, recreation areas, etc.

#### DEVELOPMENT OF PLANNING GEOMETRICAL INTERPRETATION

The expression of the spatial distribution of the main urban processes is rather complex and controversial. Streets and roads form planning structure of the city. Three main forms of urban planning - centric, linear and lattice - were known in ancient times, when the first cities emerged. Various combinations and modifications of these basic forms can be seen in the plans of modern cities. Such integral city plans are of the greatest city-planning interest. Development of planning geometrical interpretation is conventionally represented as follows.

1. Point, center, circle – have no direction of growth, the function is a static one.

The circular plan originates from the natural development of the city around the primary core, which historically represented a road intersection. Circle or polygon, having a

minimum perimeter and equal access to the center met the requirements of defense in the best possible way. The main disadvantages of city plan:

- when increasing radius, functional connections of territories are violated,
- Lack of the reserve area for the expansion.

Therefore, in modern design practice expediency of use of round or polygonal radial-ring plan should comply with the following conditions:

- The size of an urban area doesn't exceed the radius of walking accessibility from the center according to regulatory documents.

Clear regulation of urban development beyond designed outer fringes (for towns). Functionally, such a plan is simple and convenient, and doesn't require complex pedestrians isolation from transport and provides urban residents with close accessibility of the suburban environment.

2. The line, a strip, a row – develop in two opposite directions, the function is a dynamic one;

Linear city plans are formed through historical aspect of arrangement of the main transport ways or settlements along the rivers. General pattern of linear plotting is based on differentiation of city traffic – lengthwise and crosswise.

For simple primary form of linear city plan typical width corresponds to accessibility for pedestrians and length is longer if the speed of public transport increases. Transport accessibility time between opposite points of a closed circuit is also reduced twice compared to the extreme points of disconnected line segment of the same length. Primary linear form of the plan can function properly and be kept until the city growth exceeds the limits of time proximity.

Being closed, linear-circular shape of the plan can't provide longitudinal growth. If there is a need of further territorial development, it can be achieved by adjunction of new rings. Thus, at the junction and intersection of rings the most expedient places for the city centers are recorded. The double planning ring – "eight" – having the same

length as a simple ring allows to reduce by half trip time from the center to the suburbs. Application linear – circular forms of the city plan provides:

- Intensity of high-rise development concentrates in a radius of foot availability round stopping places of city public transport;

- High-speed highways at the intersection with pedestrian walkways should be placed out of earth level. Linear – branchy form of the city plan is characterized by splitting of the main roads as they move away from highways, and also by oblique-angled roads in respect of driveway junction with the house surrounding blind pass parking's. When joining the neighboring blind passes into the continuous driveway, branchy form of planning turns into linearly – loopback or lattice one. Linear – branched form of the city plan has the following features:

- the absence of any crossing of transportation and pedestrian routes on the same level;

- compatibility with any natural conditions.

Simple linear city map can be transformed, thus forming new, secondary lines, perpendicular to the main line.

3. Square, lattice - develop in several mutual directions, their function is either neutral or combines elements of statics and elements of dynamics.

The rectangular city planning grid has always been the result of purposeful design, but not intuitive spontaneous construction. The rectangular lattice-shape plan, unlike centric-circular, evenly duplicates all traffic directions without overloading of the city center, which is provided with relative freedom of spatial development.

Simple square – shaped city plan combines the convenience of a right angle with the maximum compactness.

The increase in the size of the city, as a rule, deforms the square plan under the influence of functional and transport and landscape factors. Besides, designed composition change of a square shape of city map is also possible by means of obtuse and acute angles, curves or broken lines of its boundaries.

In square-shaped city map the diagonal grid of streets provides better accessibility between the center and its outer contour angles, than the grid parallel to a square sides.

#### FUNCTIONAL AND TERRITORIAL DIVISION OF THE CITY AREAS FORMATION

Quite often the territory in the toponimic parts of the city is of monofunctional nature. Other parts of the city, on the contrary, form multifunctional system, combining some main functions.

This is natural balance of the functional and territorial division of the city areas formation.

For example, for the historically developed industrial areas isolation and monofunctional character allows to create the best conditions both for production, and for work and service of employed workers.

On the contrary, in residential areas of the city where everyday life and leisure of citizens are concentrated, location of industrial, municipal or other facilities is unacceptable.

It would be inadvisable, because noise and heavy freight traffic badly affect the activity of these zones.

This area requires build-up of communal facilities, places where other jobs can be applied (science, management, design, banks, technology IT, etc.), as well as culture, leisure and recreation facilities.

Therefore, as a rule, these residential areas have additional polyfunctional nature.

The complex polyfunctional zone of the city is its community center – social and business zone.

City center concentrates the main functions of social,

political, administrative, cultural life and service of people.

Functional analysis of civil structure shows that all the functions of the center, as well as the city as a whole, are divided into three groups:

- activity (work) (social and political work and management, education, science),

- life (food, trade, public service, housing),
- leisure (culture and sport).

Recreational area is a special functional area, which is usually of monofunctional nature.

But this division of a functional zoning of the city areas is a problem of planning integrity of the city.

None of the functions of the city, taken alone, exists by itself.

Alternation of life cycles of work, life and recreation is a basis of urban lifestyle.

Therefore the planning structure of the city can't be reduced to the structural organization of functional zones and their elements.

It is defined primarily by their mutual rational placement and the ability to create a comfortable, constant and reliable interconnection of all parts of the city.

The key to the unity of urban spatial structure is sustainable location of production and workers resettlement taking into account technological requirements of industry, an objective mechanism of social behavior of citizens in urban settlement, sustainable development and changes in intra-urban relationships in space and time.

To perform successfully city functions about a half of the population has to be efficient and this part of the population constitutes a city labor force.

Permanent population of employable age group in the general aspect of total population ensures its stable "labor balance".

The basis of urban development is a process of concentration of the various activities throughout all historical eras.

So, concentration processes are at the heart of city growth and development.

It should be noted here that it means not only increase in volume of already existing activities, but an emergence of new types and industries and increase of their diversity.

Appropriate use of urban environment qualities provides an increase in productivity, acceleration of scientific and technological progress, new inventions in technology, discoveries in science, new trends in culture.

Compactness of the city plan, the developed system of transport communications,

less difference in indicators of intensity of land use planning and management cause an appreciation of its quality.

An important criterion for the quality of the city planning structure is travel time-weighted average to the main places of work.

The quantitative assessment of the accessibility of a certain site of the city is determined by the degree of its accessibility – how much its accessibility is above (or below) city average.

## THE DEFINITION OF THE CITY LABOR SKELETON FRAME

Models of work localization places originated in ancient towns and cities of the Renaissance period.

Regularities of geometrical dependences are traced in many theories of the cities.

But to determine key parameters of emergence of models which could designate accurate gradation of existence of the specified work localization places, it is necessary to define the concept "of the city labor skeleton frame" at first.

The labor skeleton frame is 3D design consisting of a combination of vertices and ribs which create polygon, or tissue which is directed on workforce loading and ensures work places permanency.

This creates spatial and organizational infrastructure that supports employment stability, creates a constant and continuous movement, prevents disintegration and integrity of the working space.

To obtain stable working environment it is necessary to consider a number of factors which influence its form:

- 1) labor interest,
- 2) transport accessibility to work places,
- 3) prestige of the enterprises,
- 4) sensual and emotional factor of the person and others.

The labor skeleton frame forms the system of sets of working places localizations, interconnected labor links that interact with each other and with the systems of urban environment as a whole.

The system of city labor skeleton frame is a set of objects united so that they exist (function) as a whole, creating new properties that are not available in these objects taken separately.(Fig. 1).

The structure skeleton of a labor city has complete system of labor links and consists of (see Fig. 1):

- Localization of places of work – a set of objects of application of work (labor formations) of the city, at the municipal, district and local levels,
- Labor polygon – a segment of localization of places of work which has its function and direction of a vector of development of education,
- Labor node – a single object of employment provision for the city,
- Labor links of the city – a system of

links which joins labor polygons according to the function and transport accessibility at all city levels,

- A labor vector – the direction of development of functions of labor nodes in the labor polygon.

There are several main features of the system of labor links:

- 1) integrity – city labor links should be uniform and interconnected,
- 2) structuring – each labor node should have its rank of the system,
- 3) coordination – a combination of labor links of different type, which reinforce its efficiency,
- 4) subordination of parts to one purpose – labor links have one directional vector,
- 5) an algorithmic character of activity (in logical sense) – an exception of illogical ex-

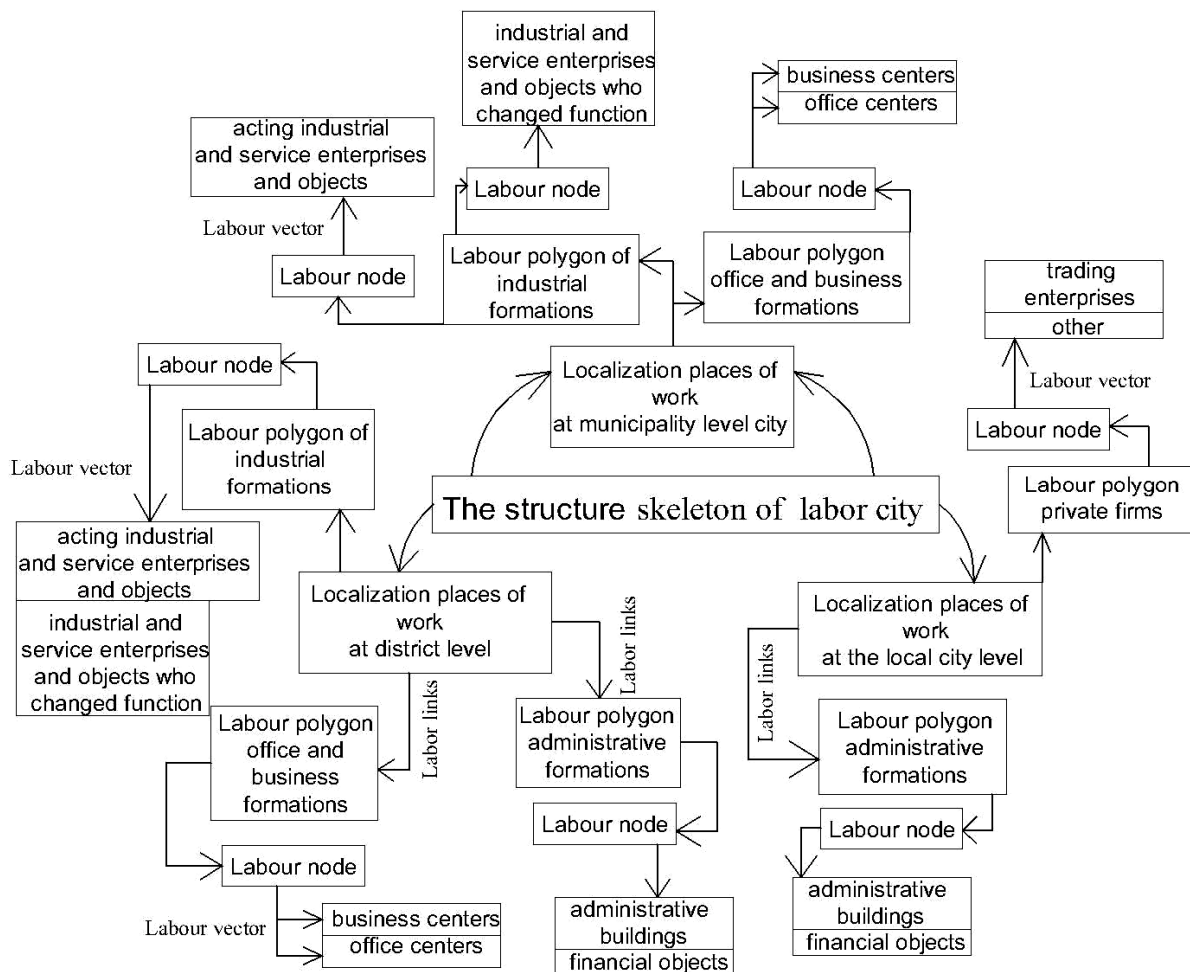


Fig. 1. The structure skeleton of a labor city

istence of the city labor links.

Types of labor links:

1. Amalgamation – is characterized by integration of two or more nodes, maintaining and supplementing stable functions.

$$Y_1^I + {}^{II}Y = Y_2^*Y$$

2. Merger – more significant link takes over less active one. Thus, the area and vectors of movement don't change.

$$Y_1^I + {}^{II}Y = Y_1^{I+II}$$

3. Opposite – when labor links are integrated their number increases exponentially.

$$Y_1^I + {}^{II}Y = Y_1^I Y_2^{II} Y_3^{III} \dots$$

Nature of labor links:

1. Disintegration is defined as the ratio of the total area of concentration of all parts of labor nodes in their total volume.

2. The focus – generalization associated with anticipation of observations and experiments results on the basis of empirical data. These empirical data "lead" to general, there fore generalization is considered as expedient truth or empirical laws.

3. Orientation – a choice of one class system of coordinates interconnected, in some sense, "positively".

Each system specifies orientation, defining a class to which it belongs.

It is described by the term "in and counterclockwise directions". Dependence of a labor skeleton frame in urban space (Fig. 2).

Depends on:

- labor potential of population (lpp),
- multifunctionality of country employment categories (mec),
- finance (f).

### CONCLUSIONS

The socio-political and socio- economic changes in the country have led to changes in

city planning concept, aiming professionals at search of new ways of city management.

Democratization of society formally invalid city-dwellers into the process of improvement of living environment.

Change of rules of public activity and a choice of homogeneous direction of vectors of city development, led to conservation of systems and immersions of the city in the closed trajectory with cycle being repeated regardless of geopolitical changes in the country. As we see, labor is very important factor in formation of urban environment. Thanks to a labor force, the population has work places which allow to realize talents and desire to produce goods which in turn stimulate market and economic relations and comfortable climate in the country in gen-

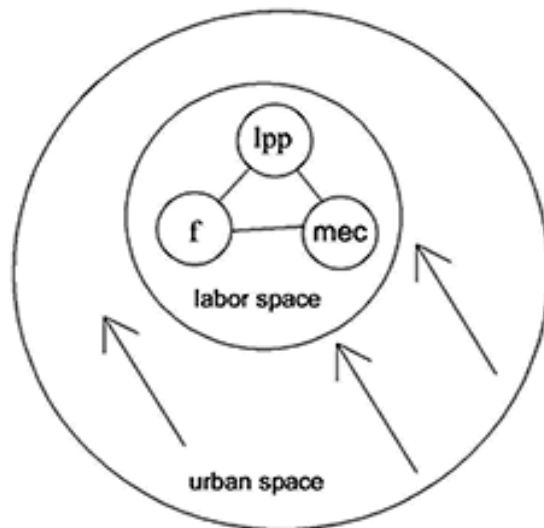


Fig. 2. Dependence of a labor skeleton frame in urban space

eral.

The labor skeleton frame of the city influences further orientation of development of functional and planning structure of the city. Each element of a labor skeleton frame should maintain integrity in the urban space and be connected to other elements of the urban framework.

Each part of the city labor skeleton frame should provide a special mode of use and, thereby, to preserve the functionality and rationality against the city background.

REFERENCES

1. **Glazychev V., 2011.** City without Borders. The territory of the future 400. (in Russian).
2. **David G. Shane., 2005.** Recombinant Urbanism, John Willey & Sons Ltd, UK, 344.
3. **Demin N., 1991.** Managing the development of urban systems. Kiev, Budivel'nik, 184. (in Russian).
4. **Jane Jacobs., 1961.** The Death and Life of Great American Cities, New York Random House, 458.
5. **Didyk V., Pavliv A., 2003.** Planning Cities, Lviv, 408. (in Ukrainian).
6. **Iodo I., 1983.** Foundation Urban Development. Theory and Methodology., Minsk, "High School", 199. (in Russian).
7. **Kevin Lynch A., 1981.** Theory of Good City Form, Cambridge, MIT Press, 514.
8. **Klyushnychenko E., 2003.** City Management: Textbook for students. Higher teaching. Book mark, Kyiv, National University of Construction and Architecture, Kiev, KNUCA, 326. (in Ukrainian).
9. **Kositsky Y., 2005.** Urban planning and territorial planning. Architectural and planning development of cities., Moscow Architecture-C, 54. (in Russian).
10. **Krasheninnikov A., 2005.** Urban development's identical development. Research experience of Western countries, Moscow, Architecture, 112. (in Russian).
11. **Ositnyanko A., 2001.** City Development Planning: Monograph, Kiev, KNUCA, 460. (in Ukrainian).
12. **Pleshkanovska A. 2005.** Functional organization planning and organization of the use of urban areas, Kyiv, Urban Institute, 190. (in Ukrainian).
13. **Pleshkanovskaya A., Savchenko E., 2011.** Cities and era, Kiev, Logos, 230 (in Russian).
14. **Polyakov N., 1965.** Basics of designing planning and configuration of cities. Moscow, 232. (in Russian).
15. **Filvarov G., 1983.** Socio-spatial organization of the industrial complex of a large city. – Kiev Budivel'nik, 255. (in Russian).
16. **Elzbieta Przesmycka, Ewa Pol., 2014.** Wooden architecture in small town planning in lublin region – state of preservation. Teka Kom. Arch. Urb. Stud. Krajobr. OL PAN, X-1, 33-40.
17. **Prusov D. Badakh V., 2013.** Principles for municipal facilities reconstruction based stability assessment methodology. MOTROL, Vol 15-5, 31-34. (in Russian).
18. **Lyudmila Ryabicheva, Yuri Nikitin, Irina Belyanskaya, 2012.** Production of copper powder from electrolysis waste products. Teka. commission of motorization and energetics in agriculture, Vol. 12, 253-258.
19. **Oleg Pogorelov, 2012.** Outline of a theory of semantic information and misinformation. Teka. commission of motorization and energetics in agriculture, Vol. 12, 210-217.
20. **Vitaliy Danich, Svitlana Shevchenko, 2012.** Models of the dynamics of the information-management architectures of the coal industry enterprises. Teka. commission of motorization and energetics in agriculture, Vol. 12, 31-35.

ТРУДОВОЙ КАРКАС КАК ФУНКЦИОНАЛЬНО-ПРОСТРАНСТВЕННАЯ СИСТЕМА ОРГАНИЗАЦИИ ГОРОДА

**Аннотация.** Модели мест локализации труда зарождались уже в античных городах и городах периода возрождения.

Закономерности геометрических зависимостей прослеживаются во многих теориях городов. Важным критерием качества планировочной структуры города является критерий среднего время поездки к основным местам работы.

**Ключевые слова:** трудовой каркас города, локализация мест работы, трудовые связи города, система трудовых связей.