Technique of Formation of Ecologically Reasonable Structure of Resettlement in the System of a Local Component of a Biospheric Complex

N A Yastrebova¹, S E Stetsenko², I N Eterevskaya³
¹Candidate of architecture, Volgograd State Technical University, associate Professor of Urban Development Department, 1 Akademicheskaya Street, 400074, Volgograd, Russia
²Candidate of Science, Volgograd State Technical University, associate Professor of Urban Development Department, 1 Akademicheskaya Street, 400074, Volgograd, Russia
³Candidate of Science, Volgograd State Technical University, associate Professor of Urban Development Department, 1 Akademicheskaya Street, 400074, Volgograd, Russia

E-mail: yas_na71@mail.ru

Abstract. The substance of ecologically reasonable territorial development of town-planning structures in the system of the Volgo-Akhtuba flood plain consists in achievement of mutually consistent steric interaction by them by its purposeful model operation on the basis of the general scientifically based regularities. Content of ecological justification of a framework of resettlement and its structural components in a zone of influence Volgo-Akhtuba flood plain assumes process of adjustment of parameters and structure of development of natural complexes, proceeding from a possibility of transformation of potential of ecosystems of the territory.

1. Introduction
The purpose of scientifically grounded transformation of spatial interactions existing in the territorial-planning complex is the formation of the urban-ecological framework of the territory on its basis. Territorial localization has the following content of the interaction process: a) a component of the biosphere complex of the Volga-Akhtuba floodplain, the forms of territorial interactions of which with the territories of its catchment area are transitory and coherent. Compliance with these conditions allows maintaining the stability of the entire ecosystem of the territory and should be carried out in the structure of the settlement framework; b) the settlement framework depends on the resources of the biosphere component and is fully localized in the catchment system of the Volga-Akhtuba floodplain. As part of the work on the method of ecologically sound structure of settlement of the territory, its components were identified: The Volgograd agglomeration, the Astrakhan settlement system and the "middle zone" between them are local planning structures, mainly rural settlements and small towns. All components of the settlement frame are in a dynamic state. At the same time, the cities-centers are constantly increasing their presence in the structure of the biosphere complex, and small towns in the
"middle zone" are losing population. Based on this provision, the content of environmentally sound interaction between the two systems involves the identification of common patterns of mutual placement in the structure of the territory. Planning formalization of the process of interaction between the two systems has allowed identifying on their basis a single territorial and spatial complex. The urban-ecological framework is a model of environmentally sound development of planning structures, formed by the consistent interaction of settlement with the natural environment [1,2].

2. Main part
The territory of the study area, in accordance with the accepted regional ecological macro zoning, is a complex spatial complex, which includes the following functional zones: a zone of high economic activity, areas cardinaly transformed by man (cities and other settlements, engineering and transport infrastructure); buffer zone - areas moderately modified by anthropogenic activity (agricultural land, recreational areas); environmental protection zone (a system of protected areas) [3].

1. The following typology of developed territories by types of environmental zones is proposed: zones of the largest and largest urban agglomerations and their suburban areas; zone of urbanized environment (territories with a network of medium and small towns); zone of poorly urbanized environment (predominantly rural type of resettlement); zone of not urbanized environment (poorly developed natural environment). Qualitative characteristics of spatial localization of territory elements (anthropogenic components and elements of the natural framework), which are based on the principles of achieving ecological balance in the territorial and spatial design: the principle of mosaic, the principle of hierarchy, the principle of continuity [4].

Implementation of complex ecological compatibility of natural and planning components of the territory is connected with revealing of their primary structural components and their parameters. The method is based on the assumption of territorial continuity in the placement of elements of the settlement framework. The main provisions of the method are the principle of revealing the composition of the primary components of the territory in the categories of "frame" and "surface" with the subsequent modeling of the options of interaction between natural and anthropogenic components of the system in order to find the optimal urban-ecological structure [5]. A model of environmental optimization, which establishes the dependence of the structure and parameters of the components of territorial interactions on the type of development of the territory. At the level of the urban-ecological framework, only the type of spatial interlocation in relation to the natural surface is fixed. Intrastructural interactions in the system of the offered division on "surface" form the constructive device of a planning method on the basis of the revealed parameters and properties of the primary components participating in the process of territorial interaction. Dimensions of the spatial module are determined depending on the structural belonging to the natural or planning surface.

Table 1. Composition and parameters of components of natural "surfaces" of different etymology in the catchment area of the Volgo-Akhtuba floodplain [7].

| Composition and parameters of natural surface components in the Volgograd agglomeration. | Composition of components | Module dimensions (ha) | Structure of interaction |
|-----------------------------------------------|---------------------------|------------------------|-------------------------|
| compact module (zonal) | 3-5 | dispersed |
| compact module (intrazonal) | 0,1-0,9 | mosaic |
| Composition and parameters of natural surface components of the Astrakhan settlement system | compact module (intrazonal) | 1-10 | mosaic |
| line module | up to a length of 3,000m; width up to 500m | dispersed |

Depending on the affiliation, the module forms a certain structure of interaction of the territory components. The method involves the introduction of a typology for external forms of territorial interaction of natural modules (dispersed, mosaic, linear) and the analysis of the internal structure of
the planning surface modules and the peculiarities of their localization in the territory (cross, grid, grid). The components of the natural surface do not require further gradation in order to study their internal structure, but only their spatial dimensions. The natural surface components include a compact module and a linear module.

At the level of large planning components, the possibility of modeling the process of inter-displacement of "surfaces" is associated with the study of the properties and microstructure of the "planning surface". The microstructure typology is based on the stability of spatial dimensions of the planning surface components. The composition of the planning categories "surface" is the identification of modules corresponding to the main components of the planning structure of a large city: large - cellular module (M1) - industrial facilities, public, civil structures, sectional development, medium cellular module (M2) - capital construction of residential areas (1940-1950 years of construction) and small cellular module (M3) - individual development (private sector).

Table 2. Composition of the planning surface of a large city in the drainage system of the Volga-Akhtuba floodplain [7].

| Composition of components | Component dimensions (ha) | Component structure |
|---------------------------|---------------------------|---------------------|
| coarse-cell component     | 9-40 (M1)                 | "The cross"         |
| medium cellular component | 4-8 (M2)                  | "the grid"          |
| fine mesh component       | 0.4-2.3 (M3)              | "the grid"          |

The composition of the planning surface of the Astrakhan settlement system is formed by the following components.

| Composition of components | Component dimensions (ha) | Component structure |
|---------------------------|---------------------------|---------------------|
| coarse-cell component     | 9-17,3 (M1)               | "The cross"         |
| medium cellular component | 2.5 - 4.5 (M2)            | "the grid"          |
| fine mesh component       | 0.4-2.3 (M3)              | "the grid"          |

Further the analysis of qualitative indicators of the revealed planning modules, namely a share of natural components in their structure, including standard indicators of territory landscaping is carried out. The next step in the spatial analysis of territorial interactions is the analysis of spatial interposition of planning modules in relation to the natural surface. In the process of modeling is the placement of planning modules in relation to the Volgo-Akhtuba floodplain - peripheral location in relation to (solid, focal) and centric location (placement directly in the floodplain) in relation to (solid, focal).

Table 3. Types of interaction of planning categories of "surface" in the system of urban-ecological framework [7].

| Type of place | Planning zones | Volgograd agglomeration | "Middle zone." | Astrakhan settlement system |
|---------------|----------------|-------------------------|-----------------|------------------------------|
| Peripheral    | Volgograd agglomeration | 'Middle zone.' | Astrakhan settlement system |
| solid         | +              | -                       | +               |
| focal         | +              | +                       | -               |
| Located inside a complex | Volgograd agglomeration | 'Middle zone.' | Astrakhan settlement system |
| solid         | +              | -                       | +               |
| focal         | +              | +                       | +               |

"+" means the presence of the node in the planning structure.

Territorial type of interaction at transverse placement of objects is "intersection". Combination of the proposed interactions with anthropogenic use of the territories of the Volgo-Akhtuba floodplain catchment area revealed deformation of the principle of transit of natural framework components in
the structure of the Volgograd agglomeration and the Astrakhan resettlement system [6]. Deformation of the principle of transitory components of the natural framework is conditioned by the form of localization of frame elements of planning structures (as a consequence of the network type of territory development). In the "middle zone" the combination of the type of location and form of localization of planning components revealed the absence of deformation of the principle of transitivity of components of the natural framework of the territory, as well as the absence of deformation of the principle of connectivity of components of the natural framework.

As a result of combination of territorial types of interaction of structural components of the settlement frame with the composition of the revealed deformations of the principles of formation of ecological stability of the natural frame, the following zoning of the structure of the settlement frame is proposed: planning zones of deformation of the conditions of transit and cohesion (Volgograd agglomeration and Astrakhan settlement system) and planning zone of compliance with the conditions of ecological stability in the systems of the State Energy Complex (Middle zone).

The composition of the planning parameters that form the conditions of "conformity" of the planning framework and the natural complex in the Middle Zone is their localization of planning structures; placement of all planning components of the settlement framework in the contact with the floodplain complex of the territories - in the "resettlement zone", as well as the dispersion of the planning components in the structure of the "resettlement zone" - spatial gaps between settlements from 8 to 15 km.

2. Intra-structural interactions in the system of the offered division into "skeletons" also form the constructive device of a planning method on the basis of the revealed parameters and properties of the primary components participating in the process of territorial interaction.

The form of interaction of frame components of the territory is the point components of the territory - knots. "Knots" are local (point) cells of the territory, in which the territorial form of interaction of frame components of the territory is carried out. The following sequence of determining the properties of "knots" and the structure of interaction is proposed: revealing the structural localization of knots regardless of their belonging to the natural or planning framework; typology of knots by combining with the territorial localization of knots is proposed.

The method of modeling the ecologically grounded structure of the urban-ecological framework on the territory of the Volga-Akhtuba floodplain drainage basin assumes the following composition of the "frame" planning categories: the main frame element, which has structural-forming functions of the planning system, beyond its spatial boundaries and the secondary frame element - local planning directions, which do not go beyond the spatial boundaries of the planning structure. The natural framework is formed by the transit frame component of the biosphere complex - the floodplain complex and local frame elements - components of natural complexes of the Volga basin.

Table 4. Composition of frame natural and planning elements of the territory of the drainage basin of the Volga-Akhtuba floodplain [7].

| Knot quality | Natural frame | Planning framework |
|--------------|---------------|--------------------|
|              | Components of the structure | Components of the structure |
|              | major localized | major secondary |
| systemic     | +              | +                  |
| supplementary| +              | +                  |

"+– means the presence of the node in the planning structure.

Hierarchy of nodes is a gradation of "system", "additional". The "system" node of the natural framework is a component whose properties make it possible (not possible) to implement the principle of transit. An "additional" node in the natural framework system can be deformed or absorbed in the process of interaction. "Systematicity" of the planning framework nodes is determined by their localization on the main or secondary planning directions of the framework. The form of spatial mismatch of the changing in time planning structure is the presence (occurrence) of systemic natural...
nodes in the planning structure. The following content of frame interactions is revealed: spatial localization in the planning structure of system nodes (1.2 type) fixes the form of territorial interaction causing deformation of a transit natural frame, whereas a considerable quantity of additional nodes in structure of planning structure (3,4 types) fix the depth of territory development. The method of formation of ecologically grounded settlement system in the zone of influence of the Volga-Akhtuba floodplain operates with the following typology of frame components.

The natural framework of the Volgograd agglomeration is formed by a combination of the transit natural complex: the riverbed of the Volga and Volga-Akhtuba floodplain and the local natural framework - elements of the Volga basin watershed (gully-beam network and small riverbeds). The natural framework of the Astrakhan resettlement system is fully formed by the combination of transit elements of the biosphere component of the Volga-Akhtuba floodplain and its delta, as well as by the lake and estuary network of contact areas with the delta.

3. The combination of the node typology with their spatial locations in the planning structure (core, suburban or external zone) has revealed the following content of planning measures aimed at "ecological optimization" of frame interactions for the Volgograd agglomeration: reconstruction of frame interactions - localization of 1.2 types of nodes in the core of the planning structure; reconstruction and compensation of frame interactions - localization of 1.2 types of nodes in the suburban and external zones of planning structure.

Table 5. Types of placement of clusters of frame components in structure of resettlement in a zone of influence of the Volga-Akhtuba floodplain [7].

| Type placements | Planning Volgograd agglomeration | Planning Astrakhan system of settlement |
|-----------------|---------------------------------|----------------------------------------|
| adjunction      | +                               | +                                      |
| adjunction      | -                               | -                                      |
| imposing        | +                               | -                                      |
| imposing        | -                               | +                                      |
| round crossing (traverse) | +                              | -                                      |

"+" means the presence of the node in the planning structure.

The planning framework of the Volgograd agglomeration is formed by the main planning axes - the system of longitudinal highways. The result of the growth of the planning system is the formation of transverse axes [8]. The planning framework of the Astrakhan settlement system is a system of finely-celled structure of longitudinal-transverse planning directions. The analysis of the structure of territorial interaction of frame planning categories in the system of city-ecological skeleton revealed the following composition: longitudinal placement of frame categories in the systems of city-ecological skeleton; transverse placement of frame components in the system of city-ecological skeleton [8].

Longitudinal placement combines the following types of territorial interactions: "adjacency", "overlap" (forward and backward), "bypass". The analysis of interactions of frame components in the system of local planning components of the Volgograd agglomeration and Astrakhan settlement system has revealed the content of deformations associated with the loss of transitory nature of the Volga-Akhtuba floodplain complex.

3. Conclusions
Generalization of the system of planning parameters that form the structure of territorial interactions for all elements of the desalination system in the zone of influence of the Volga-Akhtuba floodplain allowed to formulate the principles of urban development of the territories.
1. The principle of border development fixes development of territories within the limits of historically developed space ("settlement bands") along the floodplain complex by local planning structures. Differentiation of the development structure by the degree of anthropogenic impact on the natural base (5 km - zone of urban development, up to 30 km - zone of anthropogenic development).

2. The principle of longitudinal development is characterized by the absence of latitudinal planning links that cause deformation of the ecological potential of the natural framework, which can lead to the transitory nature of the biosphere complex - the Volga-Akhtuba floodplain.

3. The principle of disperse development should be implemented both inside the natural complex of the Volga-Akhtuba floodplain and in its contact zone. This means maintaining the settlement structure based on a consistent chain of local settlements and existing planning gaps. The rupture parameters range from 8 to 15 kilometers, ensuring that the wetlands in the Volga-Akhtuba floodplain are connected.

4. The principle of "open loop" is provided for the planning structures of large cities - centers: Volgograd agglomeration and Astrakhan settlement system [10,11]. Discrete urban development of the external zone of floodplain territories is the basis for the implementation of the principle of mosaic components of the natural complex of the Volga - Akhtuba floodplain.

Results of research are implemented in the section "recreation and agribusiness industry" when developing the Concept of sustainable town-planning development of Volgograd till 2010, the custom-made city administration of Volgograd in 1999, and also in degree design on the subject "System of Recreational Territories of the Volgograd Agglomeration", VOLGGASA, 2000.

References
[1] Vernadsky V I 1960 Biosphere Log huts 5 (M.) 236 p
[2] Vernadsky V I 1981 From history of the ideas the Chosen works on science stories (M.: Thought)
[3] Vladimirov V V 1996 Resettlement and ecology (M.: Stroyizdat) 392 p
[4] Gridnev D Z 2011 A natural and ecological framework of the territory - a basis of adoption of town-planning decisions as a part of documents of territorial scheduling of municipal units the Territory and scheduling 1(31) pp 96-103
[5] Gutnov A E 1984 Evolution of town planning (M.: Stroyizdat) 256 pp
[6] Mityagin S D 1992 Town-planning concept of the basin of Volga Basic provisions Report International fund of history of science PB 28 p
[7] Samulen'kova N A 20.12.2000 The principles of territorial development of ecologically reasonable structure of resettlement in catchment area of the Volga-Ahtyba floodplain the Thesis for degree of the candidate of architecture on special 18.00.04 (SPb GASU) pp 141
[8] Yastrebova N A 2012 Modern city: main tendencies and options of possible development Messenger Volgograd state. archit. - builds. un-t. : Construction & archit. 27(46) pp 129-136
[9] Czechowski D 2014 Topos 88 A map is worth a thousand words pp 26-31
[10] Krasilnikova E E 2015 Landscape urbanism. theory-practice: scientific monograph (Volgograd: LLC IAA "Oblastnye vesti") P.1: scientific and practical bases of landscape urbanism 156 p
[11] Czechowski D 2017 Topos 98 The urban country living of tomorrow pp 50-57