Methodology for creating a residential three-rayed space-planning structure

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Abstract. *Problem statement.* The purpose of this study is to create a methodology for designing a residential three-rayed space-planning structure for small and medium-rise
buildings. The methodology was created for the central and southern insolation zones of Russia in the conditions of sanitary standards of 2017. The methodology is applicable in countries located in both hemispheres of our planet with mirrored conditions of the Russian insolation standards.
Results. A methodology has been developed that creates many types of «daughter» residential sections based on a single «T-shaped» three-rayed residential section, which is called the «maternal». The applied result of the research was of 27 planimetric methods of architectural combinatorics and kinetics, as well as two patents. The presented methods are implemented in brick structures during the reconstruction of the residential quarter No. 75 in the historical center of the Russian city of Menzelinsk in the Republic of Tatarstan.
Conclusions. The significance of the results obtained for architecture lies in energy-efficient design, expressed in a reduction design time and an increase the types of «daughter» residential sections. The methodology was created for the future computer program for the design of multi-rayed structures of residential buildings of various storeys.
Keywords: «T»-shaped mother residential section, daughter residential sections, combinatorics, transposition, kinetics, combinatorial block, planimetry, stereometry, energy-efficient design.

1 Introduction

The purpose of this study is to create a methodology for designing a residential three-rayed volumetric-planning structure for high-density low and medium-rise buildings. The relevance of high-density residential buildings of low and medium-rise buildings is proved by many examples of foreign experience implemented at the turn of the 20th – 21st centuries, destroying the stereotypes of developers in modern Russia [1]. Based on the identified six problems of renovation of the considered quarter, the tasks of this study were formulated.

The first task is to create the urban planning flexibility of the designed residential sections using the laws of kinetic geometry. The first attempt to create it in the USSR can be considered triangular corner inserts between block able residential sections of standard

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series at an angle of 30.45 and 60 degrees. Graphically, these decisions can be seen in Fig. E.1A in the 31-107-2004 Code of Practice. But there was a rejection of the decision by future tenants because of the sharp angle inside the apartment, which was halved: into block able residential sections. The abandonment of the chosen method of urban planning flexibility resulted in empty corner spaces between residential sections. Thus, a complete solution to the problem was left to future generations of architects.

The second task: the absence in the Unified System of Design documentation of the USSR and Russia (ESKD) of requirements for the design in the planimetry of objects, with the presence of multidirectional coordinate systems that intersect at an angle orthogonal axes: «X» and «Y». They did not appear and during the design period of the residential quarter mentioned above. They are still not mentioned in the current standards: GOST 21.1101-2013 (GOST) and GOST 21.501-2018. In paragraph 5.3.2 GOST there is only one recommendation that indirectly suggests solving the problem by introducing the letters of the Latin alphabet.

The third task: the lack of technologies in the factories that produce round-hollow floor slabs of angular configuration, which are necessary for TRSPS facilities. The following three tasks related to the engineering sections of typical projects of residential series of the Soviet historical period: changing the typology of apartments in a residential section to achieve the goal required by the customer: different quantitative proportions in 4 types of apartments while maintaining their insolation.

The fourth task: replacement of the existing waste disposal system in the form of a garbage chute and garbage chambers in each residential section with the existing prohibition of their proximity to living rooms.

The fifth task: the vertical heating system of standard projects does not allow changing the types of apartments in the TRSPS and getting real energy costs in them.

The sixth task: creation of a natural ventilation system that allows you to quickly change the typology of apartments in the residential section using factory-made products. To understand the magnitude of the problem, it is enough to give three examples of absurd situations with the current system of reinforced concrete ventilation blocks (RFC vent blocks): A). Prohibition of supporting floor slabs on small-sized reinforced concrete ventilation blocks with dimensions of 400x600 mm, used in brick construction. The appearance of a polygonal ventilated room in a TRSPS with RFC vent blocks could lead the architect to cognitive dissonance. B). The laws of physics force heavy RFC vent block to be place on the foundation. The same laws do not allow the architect to start RFC vent blocks from any floor and place rooms under them, the function of which does not require ventilation. C). The standard limited air volume of 12 m3 per sanitary unit (toilet and bathroom) can be used with a single column of RFC vent blocks only within nine floors. Accordingly, for the next nine floors - from the 10th to the 18th – it was necessary to put a second column of RFC vent blocks. And under the second column, we had to put «idle» RFC-vent blocks, working as a foundation with a height of nine floors. And this is already an absurdity «squared».

2 Materials and methods

This article offers solutions to the problems of creating TRSPS, reflected in the introduction of this article in the form of a methodology for energy-efficient design. Energy efficiency is considered as the effect of the energy spent on reducing the design time. According to the Heisenberg principle: «... energy and time are considered canonically conjugate quantities and can be subject to correlation...»: formula 33.6 [2]. The essence of the methodology is to create a variety of types of daughter residential sections (DRS) from one: «T-shaped»

maternal residential section (MRS). The variety of types of daughter sections is created by the methods of combinatorics and kinetics.

Combinatorics and object kinetics are terms that are not synonymous. These are different states of the object. The combinatorics of an object is the stationary state of an object in space at the beginning and at the end of the process of its replacement by another object or by itself. Combinatorics is a branch of mathematics (geometry), applied in architecture, acquires new properties and is called architectural combinatorics [3]. One of the methods of architectural combinatorics is called «transposition». A transposition in combinatorics is a permutation of elements that swaps only two elements [4]. Architectural combinatorics is the use of the «genes» embedded in the MRS of the possibility of implementing the combinatorics and kinetics of the elements of TRSPS: structures, rooms, combinatorial blocks, residential sections, groups of residential sections, etc.

Object kinetics is an algorithm for the movement of an object that changes its position in space during movement until the goal of combinatorics is achieved. Architectural kinetics is the kinetic geometry applied to architectural objects. Kinetic geometry is a branch of the theory of machines and mechanisms that emerged in the 18th century.

The first task-the creation of urban planning flexibility, is solved within the TRSPS. But not at the junction of residential sections (as in the USSR), but inside them: in the form of three combinatorial blocks on the hinge assembly of the MRS (Fig. 1).

Like the elbow of a hand. But the elbow in the TRSPS is created for three hands - three rays of blocking. It is well known that any polygonal mesh structures can be created from the blocking of paired three rays. Ideally, the hinge assembly should be circular or polygonal, located between the staircase and elevator node (SEN) and the entrances to the apartments. But to meet the conditions of the insolation of apartments in the central and southern zones of the insolation of Russia, a «gene» of combinatorics is introduced into the hinge assembly in the form of three angles oriented according to azimuths 0, 135, 225. The assigned corners are created for three residential combinatorial blocks of TRSPS: the central one and two peripheral ones – the western one and the eastern one. Below are the methods for creating «mutations «of MRS with the «genome» of combinatorics embedded in the TRSPS in various types of DRS.

Combinatorics and kinetics in planimetry and in stereometry are based on fundamentally different methods. In connection with this circumstance, the article presents a methodology only for planimetry with the designation of the word «method» in italics. The method number is indicated by a number in semicircular brackets after the method name. For each of the 27 developed methods of architectural combinatorics, geometric kinetic algorithms are created, most of which are not graphically shown in this article due to the publisher's restriction on its volume. Five methodological goals of combinatorics are empirically determined (numbers at the beginning):

1) Creation of the DRS, differing in azimuths of the longitudinal axes of the three combinatorial blocks of the MRS.

2) Expansion of the azimuth sector of the insolation of the DRS. The goal is achieved by a combinatorial *method* that changes the type of apartments of the original one-way orientation to apartments of the two-way orientation (1).

3) Creating DRS that differ from the MRS by the types and number of apartments. The goal is achieved by six methods (letters at the beginning):

A) *The method* for blocking different types of DRS (2).

B) *The method* of merging the end structural spans of adjacent sections (3).

C) *The method* of eliminating the end structural span in one residential section in the area of joining adjacent residential sections (4).

D) *The method* of eliminating the end structural span in both adjacent residential sections in the area of their docking (5).

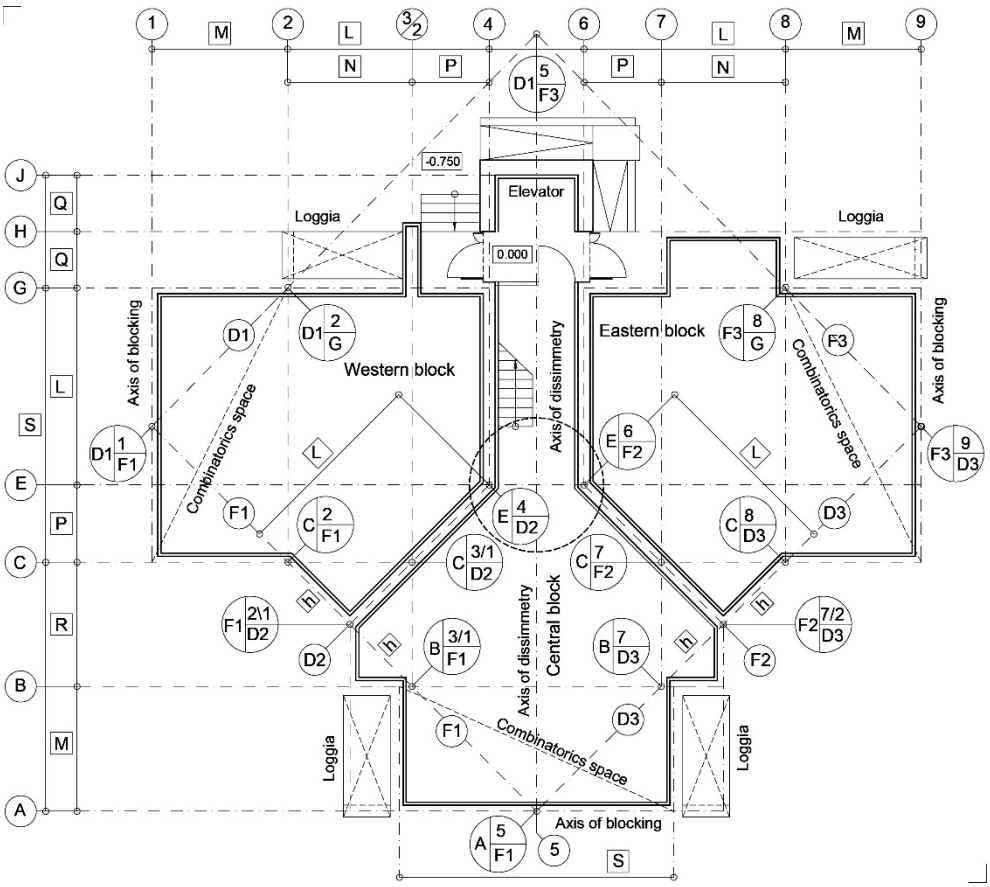

Fig. 1. The maternal residential section (MRS). (Illustration by the authors).

E) *The method* of obtaining apartments of two-sided orientation with a decrease in the number of rooms in the apartments of the section (6).
F) *The method* of increasing the number of small-room apartments per unit area of residential development (7).

4) *A method* for creating a free-plan from a variety of configurations of courtyard spaces (8).

To fulfill the above goals and objectives of combinatorics, first of all, it is necessary to create a «T» - shaped MRS. The methodology considers the level of comfort of apartments only of the «standard» type, which are determined by the order of the Ministry of Construction of the Russian Federation No. 237 / PR of 29.04.2020. In the presented methodology, *the method* of defining and approving the original module (9) is introduced, which saves the architect from developing a new series of TRSPS: with increased areas. In the attached Figs, the source module is indicated by a capital letter «A» inside the graphic square located above the dimension line. The RT architect designing TRSPS will not need to develop all types of daughter trefoils from scratch after 2025. He will only need to multiply the original module by a factor that allows the MRS to reach the value of the new regional standard: the maximum total area of the apartment per person.

2.1 The algorithm for creating «T»-shaped the maternal residential section (MRS) of the TRSPS

The algorithm is defined in nine stages:

1) Definition of the source module that creates three residential combinatorial blocks consisting of apartments of the «standard» type.

2) Creating a rotating joint of three combinatorial blocks.

3) Creation of the third and fourth coordinate axes in planimetry by *the method* of their mutual linking with the control points of intersections with the «X» and «Y» axes (10).

4) Creation of the central, western and eastern combinatorial blocks.

5) Choosing the location of the elevator in the SEN: outside the building or inside. Create conditions for people with limited mobility (PLM) in the SEN.

6) Compliance with fire protection requirements under 123 Federal Law of 22.07.2008.

7) Increasing the insolation sector of each type of DRS.

8) Exclusion of «wet» rooms in the end structural spans of the three combinatorial blocks of the MRS.

9) Introduction of the «gene» of kinetics in the DRS in order to change their apartment types.

We will decipher only those stages of the algorithm in which the «gene» of the possibility of real kinetics between the three combinatorial blocks is embedded. Let's start with the first two stages of the algorithm, which are based on five principles: A) The trefoil of the MRS should be created in the form of a plan of three combinatorial blocks: central, western and eastern (Fig. 1). B) All three combinatorial blocks of the MCC must have blind end and internal walls for the purposes of their mutual blocking, combinatorics and kinetics in the DRS. C) The coordinate axes at the blocking points of any of the three combinatorial blocks must coincide in external dimensions with each other. D) The hinge assembly is a three-rayed break in azimuths 0, 135, and 225 in the middle of the inner walls of the three combinatorial blocks. E). Creates a third coordinate system square rotated 45 degrees to the traditional coordinate system. The corners of the square should connect the midpoints of the blind outer ends of the combinatorial blocks. In the event of a fire in the apartments, it is necessary to design mechanical ventilation shafts in the hinge assembly for the removal of smoke to the roof of the residential building: so that it does not get on the escape route – SEN. The third stage: in accordance with the indirect recommendations of the standard for the design of drawings, which was in force during the renovation of the above-mentioned residential quarter, a designation system for planimetric four coordinate systems, as well as control points of their intersection, is introduced into the MRS.

Let's decipher the five mandatory conditions of the 3rd stage-the creation of three or more coordinate axes in planimetry:

A). The coordinate axes of the load-bearing structures should be at their center.

B). Creation of control points at the intersections of three coordinate systems.

C). In accordance with the last sentence of paragraph 5.3.7 of GOST, a building is considered a residential group of several DRS. Any coordinate systems of a residential group located at an angle to the «X» and «Y» systems should be attributed to other multidirectional coordinate systems. Accordingly, the recommendation of the necessity of paragraph 5 should be applied to them.3.2 GOST for their designation in Latin letters. How was this GOST recommendation implemented in the above-mentioned renovation of the residential quarter? Answer: the decision was made on the basis of the need for remote communication between the responsible persons of the organizations involved in the implementation of the TRSPS. The customer, the designer and the general contractor with the object were located in three different cities of the Republic of Tatarstan. The sound remote reproduction between them of the names of the multidirectional coordination axes of the object should be perceived equally and adequately. Accordingly, the joint decision of

the three legal entities approved the «Instructions for naming multidirectional coordinate systems of the project» (Instructions). It excluded 12 out of 26 letters of the Latin alphabet, which are a visual or sound copy of the letters of the Russian alphabet and the Arabic numeral «1»: A, B, C, E, H, I, M, O, P, T, X, Y. Accordingly, all axes located in the coordinate system along azimuths 45 and 225 were designated by one letter «D» with consecutive (from left to right) addition of Arabic numerals: «D1», «D2», etc. The axes located along azimuths 135 and 315 were designated by one letter «F», with consecutive (from left to right) addition of Arabic numerals: «F1», «F2», etc. (Figs. 1-3), The decisions of the «Instruction» were later confirmed by the introduction of the 1st paragraph of paragraph 5.3.2 GOST, which allows buildings to be assigned an independent system of designation of coordination axes. The decisions of the «Instructions» were also confirmed by the work during the Covid-19 pandemic.

TRSPS is created for a grid-like residential development. In it, one building is a closed polygonal structure with its own courtyard space. In accordance with the 1st paragraph of paragraph 5.3.2 GOST for the specified structure, an independent system with four coordination axes is created. Of these, the first two axes are traditionally orthogonal: «X» (alphabetic) and «Y» (numeric), and the 3rd and 4th axes are not traditional, since they are not specified in GOST. Because they are located at different angles to the traditional axes. In order to avoid confusion between the many traditional and non-traditional axes located at different angles, it became necessary to introduce the Latin alphabet for the 3rd and 4th non-traditional axes. In this case, both non-traditional axes are indicated only by two Latin letters (D, F) with consecutive digits attached to them. The specified scheme of designations for the 3rd and 4th axes allows you to have no restrictions on their number, indicated by numbers. This scheme eliminates confusion in the designation of multidirectional axes and in the case of subsequent axes of the 5th, 6th, etc. Accordingly, two more subsequent letters of the Latin alphabet are entered for them: G, N. Also with consecutive digits attached. The «Jewish Museum» in Berlin by the architect Daniel Libeskind is a typical building for this scheme of marking multidirectional axes.

D) Part of the coordination axes in the TRSPS should be designed for load-bearing structures that do not have foundations. This was an invention: the «Nurtamag» rigel (crossbar), which carries not only floor slabs, but also foam concrete ventilation blocks (FC vent blocks). The invention was issued in the form of two patent [5, 6]. Decoding the abbreviation of the name of the rigel and detailing its properties is the topic of the next article.

E) The coordinate axes of each of the three combinatorial blocks of the MRS should preserve the symmetry of the dimensions, but assume the dissymmetry of the external contour of the walls and planning elements inside the blocks. This condition is related to the need to correlate the types of apartments within the three combinatorial blocks TRSPS with the demography of Russia: with an average population of 2.6 persons per household [7].

TRSPS control points perform four design tasks to achieve the goal of reducing the number of options in architectural kinetics algorithms in a future computer program. Namely:

A. Linking four coordinate axes at one point and reducing the number of multiple points in the absence of their intersection.

B. Anchor points for changing the direction of the coordinate axes for load-bearing and self-supporting columns, walls, supports and FC vent blocks.

C. The anchor points of the centers of the radii of rotation or mirror reflection of combinatorial blocks when using kinetic operations.

D. Translation of the coordinates of the control points of the combinatorial blocks TRSPS in to the geodetic coordinates of the Global Navigation Satellite System

(GLONASS) on the master plan of the residential group project. The reference points for the four intersecting coordinate axes are designated as a circle with a diameter of 20 mm with three sectors orthogonal to each other and not connected to the center of the circle.

The fifth stage. From the point of view of financial efficiency, let us compare two types of SEN placement: external and internal. For comparison, we will proceed from the same area of a residential group to accommodate DRS with two types of SEN. The internal lift has one advantage: without a ramp, it lifts the PLM on the lift from the sidewalk level to the level of the floor of the 1st floor. But it has the economic disadvantage of increasing the size of the building by increasing the area of escape routes for residents. This disadvantage will require compensation by increasing the number of apartments per floor. Increasing the size of the building will reduce the area of the yard area and reduce the number of residential sections. The external elevator shown in the Figs in this article does not have the specified drawback of an internal elevator. The elimination of the external lift will allow the project to be used for a low-rise building with a large number of sections.

The eighth stage: exclusion of «wet» rooms in the end structural span of all three combinatorial blocks of the DRS. The considered exception solves a lot of social and urban planning problems by combinatorics methods, set forth below in the section «Combinatorics methodology in changing the types of apartments in adjacent sections.»

The ninth stage: changing the typology of apartments in adjacent residential sections of TRSPS. Is performed by the following methods:

A). *The method* of combinatorics inside one apartment (11).

B). *The method* of combinatorics end spans adjacent residential sections (12).

C). *The method* of combinatorics spaces apartments adjacent sections (13).

D). *The method* of placing the rigel «Nurtamag» in rooms with the «gene» of potential kinetics [14].

2.2 Methods for creating different types of daughter residential sections (DRS)

Three *methods* of architectural kinetics of combinatorial blocks are empirically determined: rotational (15), mirror (16), and mirror-rotational (17). We draw your attention to the fact that the apparent simplicity of a single rotation of any combinatorial block by a degree in azimuth will not lead to an exact binding of its coordinate axes to the axes of the other combinatorial blocks. For the algorithm of the future computer program, it is necessary to accurately describe the operations of kinetics with combinatorial blocks. Namely: A). The control points of the center of rotation (or mirror image) at the intersections of the coordinate axes. B) The rotations radius of the original block. C). The axes of the mirror image of the block. We describe in text the kinetics of obtaining three types of DRS by two methods – A and B. A). *The method* of rotational transposition (15): A.1) Algorithm for obtaining a corner residential entrance with an azimuth of 315: north-west. The end result is a ттransposition: the east block is rotated to the northwest (Fig. 2).

A.2). The algorithm for obtaining a corner residential entrance with an azimuth of 45 is performed by method A.1, but mirrored. The result is a permutation with a turn: the western block turns to the northeast. A.3). The algorithm for creating a rotary residential entrance with 90 degrees between the peripheral combinatorial blocks (west and east) repeats methods A.1 and A.2 with their final transposition azimuths 45 and 315. B). The algorithm for obtaining a different azimuth of the original block is carried out using the mirror kinetics *method* of the original block itself (16). B.1). *The method* of mirror-rotational kinetics (17). It uses the 15th and 16th methods of the original block. There is no transposition in this method. The result: a mirror image of the western block, rotated by azimuth 315.

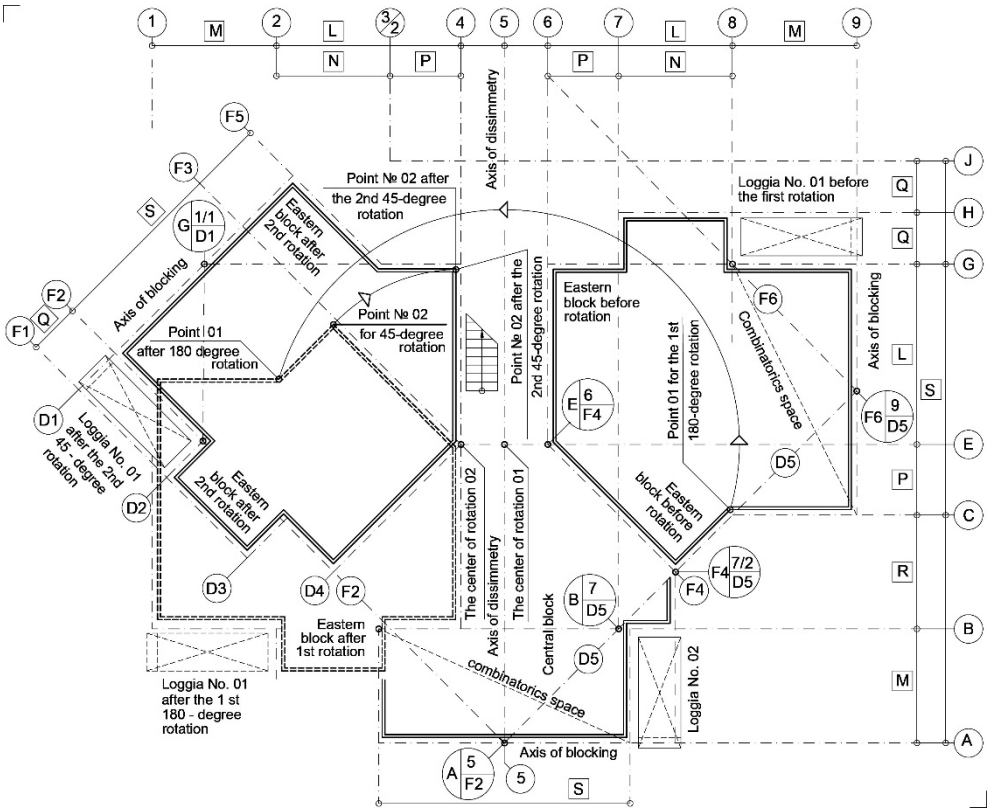

Fig. 2. Method 15: The creation a daughter residential section (DRS) with an azimuth of 315. (Illustration by the authors).

2.3 Methods for changing apartment types in daughter residential sections (DRS) of TRSPS

The methods should address the following five objectives of the TRSPS project assignment:

1) Increasing the number of preferred apartment types. 2) Provision of residential rooms of apartments with normative or excessive insolation. 3) Creating a two-way orientation of living rooms in apartments. 4) Creating a car drive-through the section. 5) Creating a pass-through terrace for an apartment on any floor. These five problems are solved by the following methods of kinetics:

A). *The method* of turning the living room of a 3-room apartment in the peripheral combinatorial blocks by 90 degrees turns the apartment into a 4-room apartment (18). And vice versa (Fig. 3).

B). Combinatorial *method* for replacing two apartments of one type with one apartment of another type in the central combinatorial block (19). The method replaces two one-room apartments with one three-room apartment. Changing the types of apartments in TRSPS is solved by one main and two additional methods.

C). *The main method:* merging the end structural spans of two adjacent sections, which are blocked together (3). The result of the method is shown in the form of a median fragment of the DRS in the area of blocking the end structural spans of the «Z»–shaped 2-entrance residential section (Fig. 4).

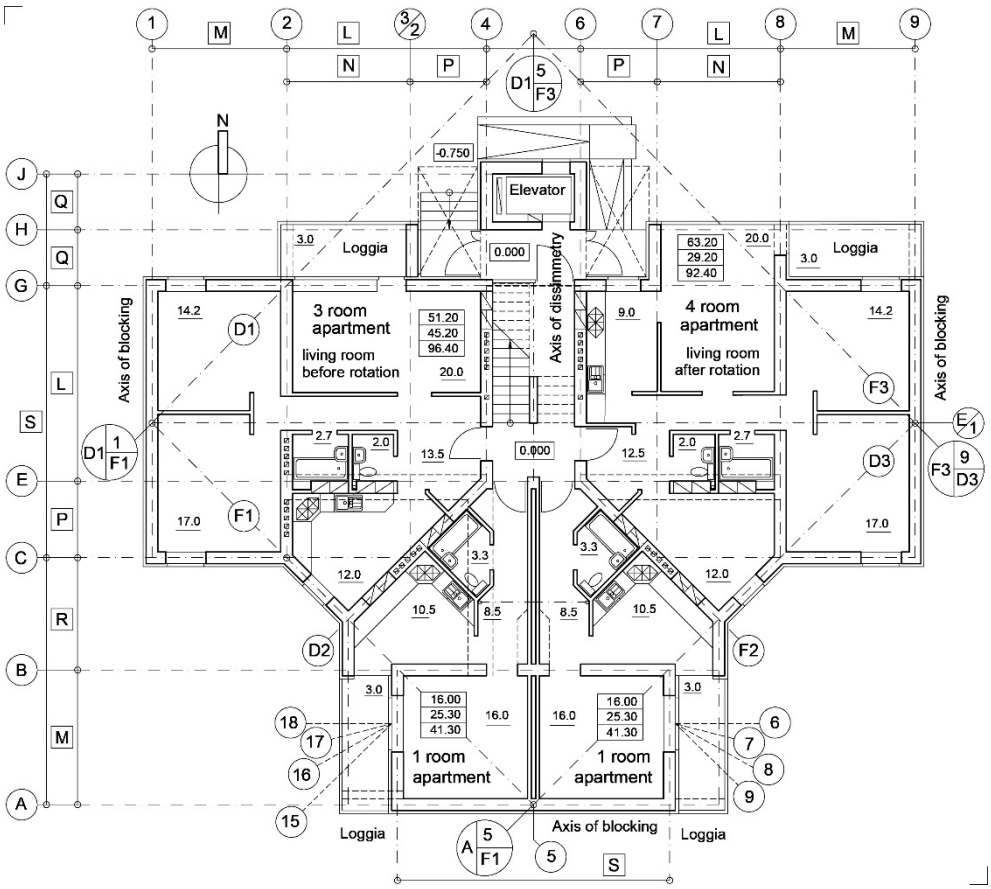

Fig. 3. The maternal residential section (MRS). (illustration by the author).

This method allows you to solve five problems: 1) Changing the type of apartments of the neighboring DRS. 2) Reducing the number of living rooms in the end apartments of the DRS. 3) Creating a two-way orientation of the living rooms of the apartments of the neighboring DRS. 4) Creation of a through opening between adjacent sections for the organization of through ventilation of the yard. 5) Creating a through passage for all types of transport between the sections of the first floor, as well as a through pedestrian tunnel. The third method allows us to obtain two additional methods of combinatorics: C.1) *The method* of placing in the space of the merged end structural spans of two residential rooms of apartments belonging to adjacent sections (20). C.2) *The method* of replacing the end structural span of one section with a similar span of another section (21). In this method, one of the sections loses its end structural span. The method preserves the number of apartments in both sections, but changes the typology of their final apartments. D) *A method* for replacing the two end structural spans of the blocked sections with a third section: a low-rise one with an unconventional type of staircase (22). *Method* of creating multi-level apartments for different related generations (23) (Fig. 4. B).

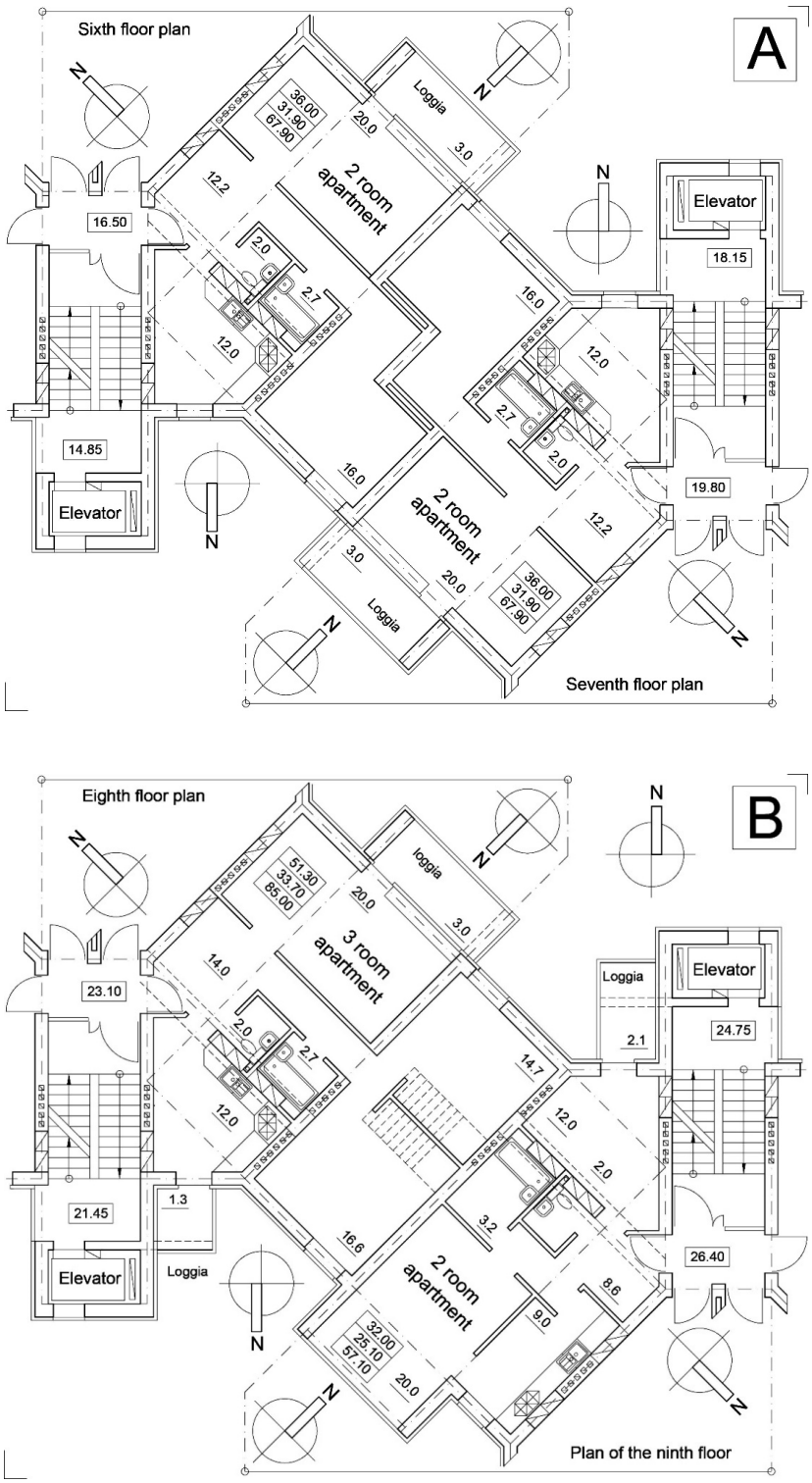

Fig. 4. The central fragment of the «Z»-shaped DRS. (illustration by the authors).

2.4. Method of changing the types of daughter residential sections by blocking with themselves

The two methods below are blocking a DRS with its own copy. Only before blocking, the copy of the residential housing must be rotated 180 degrees. *A method* for creating a «Z»-shaped two-section building assembled from two sections with the azimuth of the western combinatorial block at 315 degrees (24). Method symmetry: with an eastern combinatorial block with an azimuth of 45 degrees. *A method* for creating an «X»-shaped 4-rayed two-section residential building. (25). It is created by locking the central combinatorial blocks of the rotary section. *The method* of changing the types of DRS by blocking with other types of DRS (26). *Method* of creating a grid-like residential development (27).

3 Results

The first task is solved by 27 methods based on the introduction of a three-azimuth combinatorial hinge assembly into the MRS TRSPS. The methods are described in the «methods and materials» section of this article. The second task is solved by the «Instructions» developed at the time of the project renovation of the residential quarter in question. The positions of the instructions are explained in section «2. Materials and methods» of this article. They must be entered in the USDD for the design of objects in multipath systems. The third task was solved by the introduction of additional equipment in the technology of the factory, which made it possible to perform the corner ends of the round-hollow floor slabs. The fourth task is solved by using disposers. The fifth task is solved by the apartment-by-apartment horizontal wiring of the heating and water supply system. It made it possible to implement the combinatorics of apartments without recalculating the heating system. The sixth task is solved by the invention of the author of the article in the form of the «Nurtamag» rigel, mentioned above [5, 6]. Rigel eliminated all the absurd cognitive situations described in the sixth problem of the section «1. Introduction» of this article. Detailing the universal capabilities of the Nurtamag rigel – is the topic of another article. The next stages of the methodology are the creation of graphical and mathematical algorithms of architectural kinetics in stereometry for a future computer program designed for the design of TRSPS of multi-storeys buildings of various functional purposes.

4 Discussion

The first question of the discussion of TRSPS: is there an increase in the cost of building a square meter of apartments with a complicated configuration of the perimeter of the residential housing? The empirical experience of Turkish scientists in determining the difference in the cost per square meter of

residential buildings with different perimeter configurations, even placed in seismic conditions, refutes this assumption [8, p. 34]. The second question of the discussion: is the public space created in a high-density residential development comfortable? Research conducted in the USA on this topic after the 2008 crisis revealed satisfaction with the living conditions in the development in question. Considering the inevitability of expanding the composition of the family, the presented methodology provides methods for increasing the number of rooms without changing the structures, which must be retained in the section of the project «building operation» [9]. The third question of discussion: will deeper studies of multidirectional coordinate systems help the emergence of new architectural forms, directions and styles? The answer is several completed projects in the USA and Europe, presented by Peter Eisenman in his book «Ten Canonical Buildings. 1950-2000», each of

which was the pioneer of a new direction in the architecture of the 21st century [10]. Objects that use multi-directional coordinate systems were combined into a new architectural style, previously called deconstructivism [11]. The style was not based on two coordinate systems of planimetry, but on stereometry with the introduction of several coordinate systems [12]. On the objects of the architect Frank Gehry, multidirectional coordinate systems were implemented in the folds of the facades of buildings [13]. Until now, the principles of stereometry have mostly not been applied to residential buildings. The exception was the residential complex «Vertical Village» in Singapore by architect Ole Sheerin [14]. The object applies the minimum module of the residential group, which has different historical names. In the nineteenth century – urban blocks [15]. Today – face blocks [16, P. 23]. The extreme module implies that a resident on one side of the yard can see and remember the face of a person on the opposite side of the yard. The need to create modules during the process of teaching students BIM technologies in the design of architectural structures and grid spaces is also expressed by domestic scientists [17].

5 Conclusions

1. The advantage of TRSPS is energy-efficient design, which allows you to create a full range of DRS from a single MRS based on the presented 27 methods of architectural combinatorics, transposition and kinetics. Of these can create any composition of residential development.
2. An indispensable condition for the creation of the MRS should be the presence of three spatial and structural elements in it: A) The end structural span in all three combinatorial blocks should be free of wet room. This condition creates the possibility of changing the typology of apartments of adjacent sections in the area of their blocking. B) The use of the «Nurtamag» rigel (crossbar) with longitudinal ventilation perforation [5, 6], creates a lot of planning possibilities that require writing a separate article. C) The space of the balcony of the living room of the apartment, to be interpreted as a space for a prospective change in the typology of the apartment using the methods of combinatorics and kinetics.
3. The creation of MRS will require additions to the USDD to designate multidirectional coordination axes intersecting at an angle the planimetric orthogonal axes: «X» and «Y». The following axes are necessary for the control points of the intersection of the coordination axes, the centers of the radii of the kinetics of the three combinatorial blocks of the sections, and the binding of the Nurtamag rigel to the supports between the floor slabs.

Acknowledgements

We express our gratitude for the implementation of the TRSPS in the 75th quarter of Menzelinsk:
* To the Director of the Housing Fund under the President of the Republic of Tatarstan – Abdullin Talgat Midkhatovich, who ventured in 2001 to apply the proposed TRSPS for the considered quarter;
• «To the Department of Urban Planning Cadastre» represented by: the head of the Department - Pos Nikolay Fedorovich and the Head of the Project Department of the Department-Gubareva Galina Vasilyevna for the unique working documentation of the TLOPS project.
* JSC «Cellular Concrete Plant» represented by: General Director – Salimgarayev Farit Mukhametshovich and Chief Technologist-Naiman Adiba Nurmievna for the introduction of a unique option for creating corner ends of serial floor slabs into the traditional technology of production of round-hollow floor slabs

References

1. V. L. Glazychev, Urban studies. Part 2 (Europe, Moscow, Russia, 220, 2008)
2. Heisenberg's uncertainty principle. Helpiks.org: internet assistant. 2016. URL: helpiks.org/7-1348.html (last accessed: 15.12.2020)
3. E. S. Pronin, Theoretical foundations of architectural combinatorics (Architecture-S, Moscow, Russia, 2004)
4. Transposition, 2010 URL: dic.academic.ru/dic.nsf/ruwiki/201442 (last accessed: 15.12.2020)
5. Reinforced concrete frame with a flat floor: pat. No 130328 of Rus. Federation, 2013107051/03; declared 18.02.13, published 20.07.13, Bul. No 20
6. Precast reinforced concrete frame: pat. No 132814 of Rus. Federation. 2013107055/03; declared 18.02.13, published 27.09.13, Bul. No 27.
7. All-Russian Population Census 2010 URL: www.demoscope.ru/weekly/ssp/rus_hh_10.php (last accessed: 15.12.20)
8. Zeynep Yeshim Elerisoy, *Effects of Height and Plan Geometry on the Costs of Tunnel Form Residential Buildings,* Periodica Polytechnica Architecture, **49**(1), 29-37 (2018) DOI: 10.3311/PPar.12384
9. Yunmi Park, *Does new urbanist neighborhood design affect neighborhood turnover?* Ewha Womans University. land use policy, **68,** 552-562 (2017) DOI: 1177/0885412214549422
10. Peter Eisenman, Ten canonical buildings 1950-2000 (Strelka press, Moscow, Russia, 239-299, 2017)
11. Aida Hoteit, *Deconstructivism: Translation From Philosophy to Architecture*, Lebanese Universit, January (2015) DOI: 10.3968/7240
12. Ahmed Ibrahim, *Deconstructivism: style, Follies and founders*, University of Hail (2018) DOI: 10.13140/RG.2.2.30449.17765
13. Sandra Schramke, *3D-Code: Folding in the Architecture of Peter Eisenman*, Cluster of Excellence Humboldt-Universitätzu Berlin (2016) URL: www.semanticscholar.org/paper/3-D-Code-%3A-Folding-in-the-Architecture-of-Eisenman/e21afe3ca6cc676515307fbfe9e53b369205fdc6?p2df (last accessed: 17.05.2021)
14. *A vertical village of living and social spaces integrated with the natural environment* Website of architect Ole Scheeren (2004) URL: buro-os.com/projects/the-interlace (last accessed: 15.12.2020)
15. *The feeling of a ghetto is created,* m.lenta.ru: daily. online edition 23.07.2019 URL: m.lenta.ru/articles/2019/07/23/urban (last accessed: 17.05.2021).
16. Yunmi Park, *Neighborhood Planning Theory, Guidelines, and Research: Can Area, Population, and Boundary Guide Conceptual Framing,* Journal of Planning Literature, **30**(1) (2015) DOI: 10.1177/0885412214549422.
17. Sergey Mikhailov, *BIM-technologies and digital modeling in educational architectural design*, IOP Publishing: IOP Conf. Series: Materials Science and Engineering, **890**, 012168 (2020) DOI: 10.1088/1757-899X/890/1/012168