

Method of calculation and nomenclature of new types of educational complexes “kindergarten – elementary school” within the housing development

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Annotation: having studied the location of the educational complex “Kindergarten – Elementary School” within the residential development, determined the main method of calculation, and proposed the basic nomenclature of new types of educational complexes “Kindergarten – Elementary School” for the mass urban development. The nomenclature has been developed based on the following: average demographic indicators of the number of students per 1,000 inhabitants, the same maximum number per a group or a class, namely, for the kindergarten – 20 children, and for the classes – 25 students; for placement in residential blocks and residential microdistricts with the estimated population size, service radius, and sanitary protection zones between buildings and other facilities.

Keywords: residential development, microdistrict, service radius, urban construction, sanitary protection zones, kindergarten, elementary school, educational complex.

Objective

To determine the nomenclature of new types of educational complexes and special features of formation of the network of educational complexes “Kindergarten – Elementary School” in the urban housing development.

Types of educational complexes are determined by several parameters, one of which is a demographic structure of the settlement in the residential microdistrict and the student occupied zone.

Based on the analysis of regulatory documents and generalization of the design and construction practices, children’s pre-school institutions should be designed with taking into account the demographic structure of settlements, with the assumption that the estimated level of coverage of children by pre-school institutions is within 85%, including general type – 70%, specialized type – 3%, and health-promoting type – 12%.

The capacity of the first level secondary school for microdistricts is determined depending on the demographic structure of settlements, with the assumption that children of 6 to 10 years old are 100% available. The level of population coverage with educational establishments, depending on the type of settlements, may be accepted at the rate of 120–160 students per 1,000 pax, provided that 1–9 classes in schools are assumed as 100%, and 10–11th grade students – 85%. It is recommended to assume the estimated indicator of 35–40 seats per 1,000 pax for children’s pre-school institutions. The estimated indicators should be revised every 5–7 years, based on current demographic fluctuations. The analysis shows that the number of pre-school- and school-aged children in different cities and even city districts is not the same. For example, until 2020 the city of Kyiv has adopted the estimated indicator of 135 seats per 1,000 inhabitants for schools in new microdistricts, and 98 seats – in the existing housing development.

The occupied zone is the regulatory number of students in each residential block – pre- school- and school- aged children. The problem of optimal occupied zone is one of the most important in the formation of educational complex types; it should be as close to the place of study as possible. The capacity of the educational complex nomenclature should match the current nomenclature of populated areas, which is characterized with the following indicators of residential districts: 40–80; 80–120; 120–160; 160–200; 200–250. These sizes of residential structures create a basis for calculating the types of educational complexes.

To determine the required number of seats in the educational complex, and, accordingly, choose the type we need in a particular residential area, we propose the following equation:

$$N_s = \frac{d \times \left(\frac{p}{1000} \right)}{100}$$

N_s – number of seats in an educational complex;

d – number of children’s seats per 1,000 inhabitants in the microdistrict;

p – residential area population.

According to this data, it is possible to determine the need in educational complexes (EC) of the appropriate type for different Ukrainian cities.

The educational complex network “Kindergarten – Elementary School” should be formed on the basis of a wide range of educational complexes differentiated by the forms of service, capacity and allocation methods with taking into account the cooperation method. And ECs at the residential area level are formed on the basis of:

- kindergartens (children of 3 to 6 years old);
- elementary schools – 1–4 classes (children of 6 to 10 years old).

The analysis has showed that in order to meet the needs of residential areas having different population, it is advisable to develop five types of educational complexes.

Table 1. Nomenclature of Types of Educational Complexes “Kindergarten – Elementary School” for Urban Construction within Ukraine (Author’s Proposal)

| # | Kindergarten | | | Elementary School | | | Regulatory value per 1,000 inhabitants by DBN 360–92 (State Building Codes of Ukraine) | Service radius |
|--|--|--------------------|------------------|-----------------------|--------------------|-------------------|--|----------------|
| | groups | Number of children | Number of groups | classes | Number of children | Number of classes | | |
| Type I (Parallel Form 1) | | | | | | | | |
| 1 | 1 st junior group (3–4 years) | 20 | 1 | 1 st class | 30 | 1 | 70% children | 300–500 m |
| | 2 nd middle group (4–5 years) | 20 | 1 | 2 nd class | 30 | 1 | | |
| | Senior group (5–6 years) | 20 | 1 | 3 rd class | 30 | 1 | | |
| | Total | 60 | 3 | 4 th class | 30 | 1 | | |
| Total number of children for Type I – 180 | | | | Total | 120 | 4 | | |

| Type II (Parallel Form 2) | | | | | | | 70% children | 300–500 m |
|--|--|-----|---|-----------------------|-----|----|--------------|-----------|
| 2 | 1 st junior group (3–4 years) | 20 | 2 | 1 st class | 30 | 2 | | |
| | 2 nd middle group (4–5 years) | 20 | 2 | 2 nd class | 30 | 2 | | |
| | Senior group (5–6 years) | 20 | 2 | 3 rd class | 30 | 2 | | |
| Total | | 120 | 6 | 4 th class | 30 | 2 | | |
| Total number of children for Type II – 360 | | | | Total | 240 | 8 | | |
| Type III (Parallel Form 3) | | | | | | | 70% children | 300–500 m |
| 3 | 1 st junior group (3–4 years) | 20 | 3 | 1 st class | 30 | 3 | | |
| | 2 nd middle group (4–5 years) | 20 | 3 | 2 nd class | 30 | 3 | | |
| | Senior group (5–6 years) | 20 | 3 | 3 rd class | 30 | 3 | | |
| Total | | 180 | 9 | 4 th class | 30 | 3 | | |
| Total number of children for Type III – 540 | | | | Total | 360 | 12 | | |
| Type IV (Mixed, 2 Parallel Forms of Elementary School) | | | | | | | 70% children | 300–500 m |
| 4 | 1 st junior group (3–4 years) | 20 | 1 | 1 st class | 30 | 2 | | |
| | 2 nd middle group (4–5 years) | 20 | 1 | 2 nd class | 30 | 2 | | |
| | Senior group (5–6 years) | 20 | 1 | 3 rd class | 30 | 2 | | |
| Total | | 60 | 3 | 4 th class | 30 | 2 | | |
| Total number of children for Type IV – 300 | | | | Total | 240 | 8 | | |
| Type V (Mixed, 2 Parallel Forms of Kindergarten and 3 Parallel Forms of Elementary School) | | | | | | | 70% children | 300–500 m |
| 5 | 1 st junior group (3–4 years) | 20 | 2 | 1 st class | 30 | 3 | | |
| | 2 nd middle group (4–5 years) | 20 | 2 | 2 nd class | 30 | 3 | | |
| | Senior group (5–6 years) | 20 | 2 | 3 rd class | 30 | 3 | | |
| Total | | 120 | 6 | 4 th class | 30 | 3 | | |
| Total number of children for Type V – 480 | | | | Total | 360 | 12 | | |

According to the author, it is advisable to introduce a flexible structure of kindergarten or elementary school with the possibility of changing from time to time the number of groups in the kindergarten and classes in the elementary school, depending on a specific demographic structure of the microdistrict and child population. This will provide some mobility and variability throughout the educational institution network.

For practical purposes, the degree-seeking student has offered the basic nomenclature of types of educational complexes for the mass urban development (Table 1). The nomenclature was developed on the basis of the following: average demographic indicators of the number of students per 1,000 inhabitants; the same maximum number per a group or a class, namely, for the kindergarten – 20 children, and for the classes – 25 students; the optimal (in terms of pedagogy and hygiene) total capacity of the educational complexes.

The nomenclature includes the kindergarten, which consists of two junior and one middle groups, and the elementary school (1–4 classes). There are different combinations and types of completeness of them in the structure of one educational complex “Kindergarten – Elementary School”:

- Type I – single kindergarten + elementary school (with one parallel form (3 + 4), which have 60 pre-school-aged children and 120 students; total capacity – 180 children and students.
- Type II – double kindergarten and double elementary school (6 + 8), which have 120 pre-school-aged children and 240 students; total number of children – 360.
- Type III – triple kindergarten and triple elementary school (9 + 12), which have 180 pre-school-aged children and 360 students; total number of children – 540.
- Type IV – with unequal completeness, for example: double kindergarten and double elementary school ((3 + 8) 1st group of kindergarten and two parallel forms of elementary school), which have 60 pre-school-aged children and 240 students; total number of children – 300.
- Type V – with unequal completeness: double kindergarten and triple school ((6 + 12) two groups of kindergarten, and three parallel forms of elementary school), which have 120 pre-school-aged children and 360 students, total number of children – 480.

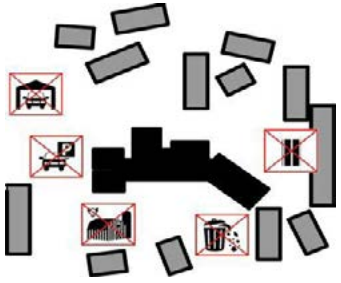
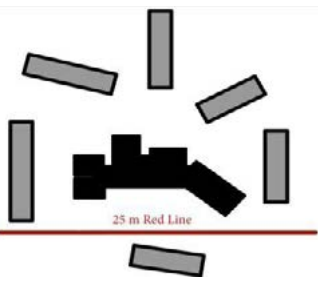
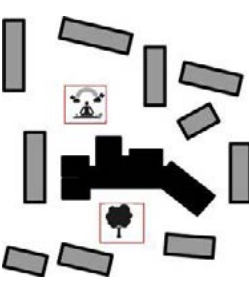
The educational complexes “Kindergarten – Elementary School” shall be uniformly located in the territory of urban and rural settlements. The service radius for the pre-school institution facilities is 300 m in urban residential blocks and microdistricts with multi-storey buildings, according to the current building codes, and 750 m – in rural settlements and towns with one and two-storey buildings. The regulatory service radius for school establishments is 500 m.

As we can see, the regulatory requirements for the location of children’s pre-school institutions and elementary schools vary significantly. The service radius of schools is almost 2.5 times higher than kindergarten’s. The thesis analysis of city-planning decisions shows that the service radius of educational complexes “Kindergarten – Elementary School” should be defined locally depending on the specific city-planning conditions. Thus, when planning the residential microdistrict diagrams that provide direct convenient way to the educational institutions, the service radius may be 500 m. In some cases, when meeting relevant sanitary indicators, the service radius may be 750 m. On the steep terrain and in case of difficult planning decisions, it is reasonable to take a minimum radius of 300 m. Pedestrian and transport accessibility to the children’s pre-school institution in rural areas should not exceed 15 minutes.

The educational complexes should be located in the most comfortable specially designated areas near parks and garden squares in the territory free of marshes and floods with low levels of groundwater, and without harmful neighbourhood – waste containers, garages, boiler rooms, parking lots, cemeteries, waste deposits, livestock and industrial developments, etc.

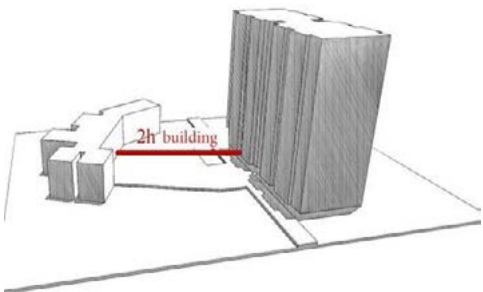
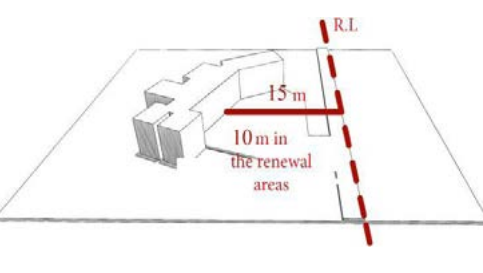
The educational complexes should not be located directly near the main roads of municipal or regional importance. They can only front the residential streets of local importance provided that ECs should have the access way from the direction of residential street. The building of educational complex should be located at the site with a space before the red lines of at least 25 m and ensure access from the direction of residential street. The children’s main rooms (dining and playing rooms and groups) should have southeast or east orientation in accordance with standards. The windows of children’s rooms are not permitted to have north, north-west and northeast orientation (see Table 2).

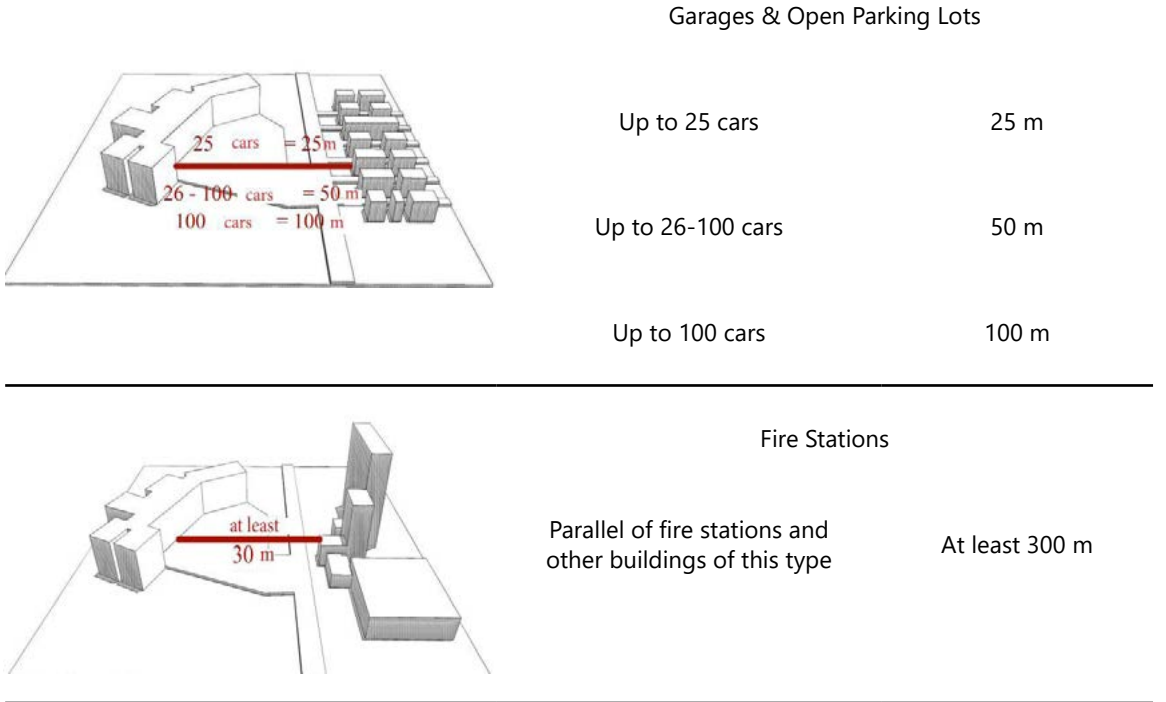
Table 2. Educational Complex Territory Requirements

| The building should not have adverse neighbourhood | The building should be located at the site with a space before the red line of at least 25 m | The building should be located in the most comfortable areas near parks and garden squares |
|---|--|--|
|  |  |  |

Location of the educational complex in the housing development should comply with the sanitary and healthy and fire safety requirements. The sanitary protection zones between the buildings of educational complexes and other facilities should be taken as follows: between long sides of buildings – two heights of the nursery and kindergarten; between gable facades of buildings with windows and long sides and gable facades of these facilities – one building height, but at least 12 m; between long sides of the kindergarten (where playing rooms and groups are located) and public and residential buildings – at least 2.5 height of the highest opposite located building. The distance from the green land plot of the educational complex to the opposite located houses from the east and south sides should be at least 1.5 m height of these objects (see Table. 3).

Table 3. Sanitary Protection Zones Between Buildings

| Diagram | Zone Type | Zone Size |
|---|---|--|
|  | <p>Between long sides of buildings</p> <p>Between long sides and gable facades of buildings without windows</p> <p>Between gable facades without windows, and between one-story buildings</p> | <p>Two buildings height</p> <p>One building height, but at least 12 m</p> <p>According to the fire break regulations</p> |
|  | <p>From the red line</p> <p>From the red line in the renewal areas</p> <p>From the red line to ancillary facilities</p> | <p>15 m</p> <p>10 m</p> <p>6 m</p> |



The complex master plan should take into account the surrounding natural and architectural environment, should define the role and place of educational establishments in the adjacent buildings, determine major and minor access ways to the front and utility zones and location of playgrounds and sports fields, landscaping and so on.

The entrance to the complex area is advisable to be within the front facade zone, close to the public transport station. It is necessary to provide the protective green line (trees, bushes, grass) of at least 1.5 m width along the perimeter of the land plot of the educational complex, and at least 3 m from the street side. The width of driveways around the elementary school and kindergarten should be at least 3.5 m.

It is recommended to divide the territory of the educational complex into three interrelated areas: around the buildings and structures of the children’s pre-school institution, elementary school and shared cooperative use facilities.

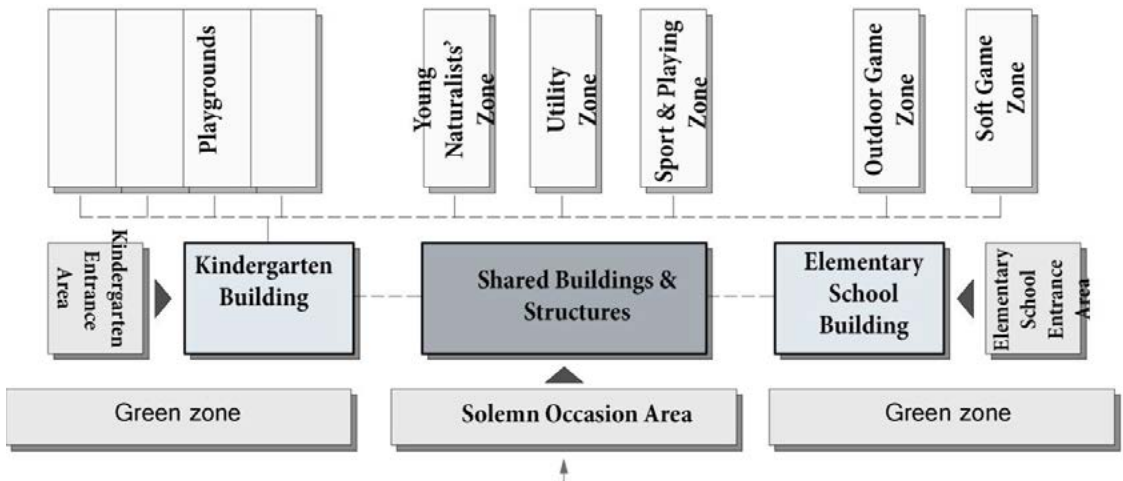


Fig. 1. Functional Zoning Diagram for Buildings and Structures in the Kindergarten and Elementary School Complex Territory

It is necessary to provide the development area (kindergarten building), entrance area, playgrounds, and green zone on the pre-school institution land.

The land plot of the elementary school should include the studying area (elementary school building), entrance area, soft game zone, outdoor game zone, teaching and production site, educational and research platform, and open air classes (see Fig. 1).

It is advisable to block some playgrounds and buildings on the EC site.

It is recommended to consider among shared cooperative facilities the following: sports and playing zone, utility zone, young naturalists' zone, and solemn occasion area.

If the site is located in difficult terrain, it is recommended to arrange terraces, retaining walls, slides, etc. The pre-school institution site should have 1.8 m fence around.

In case of the educational complex having partial cooperation of service areas and facilities, it is necessary to arrange the pre-school institution territory as follows: the development area, group playground area, young naturalists' and green zones. It is necessary to arrange the elementary school territory as follows: the development area, open air classes and leisure area with greenery. Sports and utility zones are connected.

If the educational complex has a deeper level of cooperation of teaching facilities and resources, it is possible to arrange the shared development area, sports, utility, young naturalists' and other zones, depending on local conditions.

When placing buildings in the educational complex territory, it is necessary to take into account the sanitary and healthy and fire safety requirements. All the buildings and grounds should be well-lighted and protected from the negative effects of the environment (noise, air pollution, etc.).

In forming the educational complex "Kindergarten – Elementary School", a big attention should be paid to the landscaping. Only environmentally friendly materials should be used for covering the grounds. If possible, it is advisable to divide the leisure area, playing zone, waiting area, and utility zone by means of relief. Selection of green plants should ensure the availability of greenery throughout the year.

Conclusion

The proposed types are recommended for the residential blocks and microdistricts with the estimated population. The nomenclature above is for a general methodical purpose. To make specific calculations of the EC network, we provide average indicators, which may be adjusted according to the local city-planning conditions and demographic parameters, pedagogic techniques and available teaching facilities and resources; other completeness of pre-school groups and classes may be provided for the new housing development in Ukrainian cities.

An active impact of the city-planning factors on the formation of educational complexes determines consolidation and compactness of residential development that affects further improvement of the formation of ECs' functional and planning structure based on the flexible planning organization: it requires the improvement of methods and techniques of space organization, search for new effective planning decisions that allow to flexibly address the city-planning issues.

In addition to pedagogic benefits, the creation of such complexes makes it possible to flexibly respond to demographic fluctuations, and, if necessary, change the kindergarten's function to the elementary school's, and vice versa. Flexibility and multi-choice of the teaching environment is one of the main concept of the network creation and typology of educational complexes at this stage, and it is a structural element of the school network in the compacted mass urban development.

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