

Increase in Population Density and Aggravation of Social and Psychological Problems in Areas with High-Rise Construction

Elena Romanova¹*

¹ Moscow State University of Civil Engineering, 26 Yaroslavskoye shosse, 129337, Moscow, Russia

Abstract. High-rise apartment houses have technical and economic advantages in areas with dense population. Their placement in the central part of the city allows increasing the number of living space in the limited territory, to bring population to the place of employment and reduce pendular migration. But increase in population density leads to psychological problems: level of a stress, fatigue increases, the number of phobias grows, infectious diseases extend quicker. These problems can be solved at resettlement of inhabitants to the suburb. However such decision leads to aggravation of a transport problem and the pulsing increase in population density in the downtown and on its suburb. To solve a transport problem, it is necessary not to increase the square of the cities. Therefore in the suburbs is also used high-rise construction. But high-rise residential districts on the suburb of the city get own social problems which are capable to destroy all advantages of high-rise construction.

1 Introduction

High-rise apartment buildings have technical and economic advantages in areas of high population density. They have become a distinctive feature of housing accommodation in virtually all densely populated urban areas around the world. In contrast with low-rise and single-family houses, apartment blocks accommodate more inhabitants per unit of land area and decrease the cost of municipal infrastructure. A means of assessing population and building densities at the same time is often used measure dwellings per hectare. It is a useful proxy for comparing housing projects.

A concept “density” is borrowed from physics where the meaning is clear – mass divided by volume. Yet when it transferred to the city, nothing is so simple. Concentrations of people are generally measured as residents per hectare based on census data. But it's wrong. Population densities cannot be based on residents alone, since the numbers of people in a given neighbourhood at a given time include those who work there or are visiting. In a mixed-use neighbourhood, residents may be a small proportion of the population density.

Also there is the distinction between gross and net densities. For this assessment we also incorporate water bodies, freeways and unbuildable sites, so the average density

* Corresponding author: romanova_e_v@mail.ru

diminishes. The gross density is always lower than net density and it is the one that matters in debates over urban density.

This indicator in Russia is regulated Construction Norms and Regulations 2.07.01-89*. The recommended density (gross) for the cities with various number of inhabitants (from less than 20 000 – to over 1 000 000): high – 130-220 persons/hectare, average – 190-210 persons/hectare, low – 70-180 persons/hectare. For territories of various town-planning value she can increase or decrease: "... population density, as a rule, shouldn't exceed the 450 persons/hectare" and to be "not less 40 persons/hectare" [1]. But even in large megalopolises and the regional centers these norms aren't carried out. So the most densely populated region of Russia on density - the city of Moscow has density of 4 834,31 people/km² that is made by 48,3 persons/hectare. It is slightly higher than the minimum border! For comparison: before accession of the new territory population density in Moscow was 105,8 persons/hectare.

With the greatest population density except Moscow have entered the five territorial subjects of the Russian Federation: St. Petersburg – 37,6 persons/hectare, Sevastopol – 4,9 persons/hectare, the Moscow region – 1,7 persons/hectare, the Republic of Ingushetia - 1,3 persons/hectare. In other cities and regions population density has made less than one person on hectare [2]. The chief architect and the head of the Council on development of city infrastructure from Barcelona, professor José Asebilyo Marin, considers that low population density is the main problem of the Russian cities: "It is necessary to remember that the cities with low density are inefficient both economically and ecologically. The high density and compactness of the cities are positive lines from the town-planning point of view "[3].

Population density is not only the number of residents but fluctuates over time and with functional mix. There are also population density rhythms, as people move from place to place throughout the day and week. The same urban precinct can be densely populated during work hours and empty on weekends.

A distinction should be made between "internal" and "external" densities – the numbers of people in a room or apartment versus those in an urban precinct. At the other extreme, internal crowding largely defines a slum [4]. If you look at new high-rise housing in the evening, you can find many rooms and even apartments unoccupied.

High-rise construction reduces internal density and increases external at the same time. It promotes strengthening of individualization, autonomy of the person, estrangement from the outside world and society. The disturbing tendencies in behavior of people connected with growth of number of storeys and population density in residential zones have been described in the Soviet researchers works in the 70-80th years. Scientific interest in this problem doesn't weaken also in the 21st century [5, 6, etc.] Researches of the English and Singapore scientists [7] show negative correlation between the level of happiness and population density. If the person is the whole day among a large number of other people, he needs the place and time for a privacy. He finds such place in the apartment. So at citizens idea of the dwelling as about the sovereign territory where the entrance is forbidden strangers was gradually created. So culture, spirituality, traditions have changed.

At last, there is a question of density streetlife – concentration people in public space [8]. Here it is almost impossible to determine density. We can measure the number of pedestrians in a minute or on square meter. It doesn't give us understanding of population density and necessary density of building. This density - the fact that we often call city "noise" or "intensity" - provides the greatest contribution to social and economic development of the city together with negative elements, such as social and psychological overload.

Objective of this research is the description and the analysis impact of high-rise buildings on mental health and social wellbeing of their inhabitants.

During the research the following problems were solved:

- To classify high-rise buildings by a way of their use.
- To estimate the relation to high-rise construction of respondents in different age groups (students and teachers).
- To reveal and describe psychological and social phenomena which can arise at the person during stay in high-rise residential buildings and residential districts of high-rise building.
- To analyze the prospects of using architectural planning solutions of high-rise construction for removal psychological and social tension of the population.

2 Methods

For identification psychological phenomena which arise at the person during stay in high-rise buildings information on results of earlier conducted researches and also stories by builders-spidermen, inhabitants of multi-storey buildings and residential districts which are in free access with high-rise building have been analyzed.

The questionnaire "Your relation to high-rise construction" has helped to estimate the relation to high-rise construction in different age groups of people. The questionnaire includes a series of questions the opened and closed type and reveals opinions of the respondent high-rise construction objects in general, his preferences concerning the residence and fears connected with accommodation in the high-rise building.

The research was conducted at the Moscow State University of Civil Engineering (MGSU) in 2017. 119 teachers and students aged from 17 up to 69 years with various social statuses, income level, constantly living in Moscow and its suburb and also arrived from other cities of Russia have participated in a research.

3 Results

In practice of design and construction the most various views of buildings therefore it is possible to classify them by a large amount of signs meet. The most important in this research is classification by the following signs: to destination and on number of storeys. Here there is a set of various classifications too.

On number of storeys we can allocate low-rise buildings – 1–2 storeys, average-rise buildings – 3–5 storeys, multi-storey buildings – 6–10 storeys, high-rise buildings – 11–25 storeys, skyscrapers – more than 25 storeys [9]. As height of floors in different buildings and the different countries is various, on CIB symposium passing in 1976 in Moscow the general classification of buildings by their height in meters has been accepted.

The exact height above which a particular building is deemed a high-rise is specified by fire and building codes for the country, region, state, or city where the building is located. In Russia buildings higher than 75 m (more than 25 floors) carry to high-rise.

In book High-Rise Security and Fire Life Safety [10] addresses the following types of high-rise buildings:

- office buildings;
- hotel buildings;
- residential and apartment buildings;
- mixed-use buildings.

A mixed-use building may contain offices, apartments, residences, and hotel rooms in separate sections of the same building. Hotel-residences are another type of mixed-use occupancy.

We have asked students and teachers of MGSU about the relation to these types of high-rise buildings. 67% of respondents (generally students) are positive to construction of high-

rise buildings (higher than 11 floors). From them 43% approve construction of skyscrapers (more than 25 floors). Skyscrapers attract respondents with the positive sides: beautiful appearance, prestigiousness, an opportunity to place a large number of people in densely built up city. Other respondents have shown negative attitude to high-rise construction. They noted shortcomings: discrepancy to historical appearance of the city, high fire danger, big population density. Now 3% of respondents live in low-rise buildings, 7% in average-rise buildings, 12% in multi-storey buildings, 76% in high-rise buildings, 2% in skyscrapers. Results of the relation to different types of high-rise buildings (more than 25 floors) in Table 1.

Table 1. Relation to high-rise buildings.

Comments	Building type							
	high-rise buildings				skyscrapers			
	Office building	Hotel building	Residential and apartment building	Mixed-use building	Office building	Hotel building	Residential and apartment building	Mixed-use building
in high-rise buildings have to be ...	88%	93%	95%	37%	87%	52%	35%	63%
I visited several times	2%	22%	100%	41%	53%	12%	5%	23%
I regularly visited *	70%	-	87%	100%	1%	-	2%	32%
I live constantly*	-	-	76%	-	-	-	2%	-
I would like to live in	-	-	18%	6%	-	1%	27%	28%
I want to work in	53%	-	-	10%	31%	-	-	51%
in Moscow it isn't necessary to build high-rise buildings ...	-	-	2%	1%	2%	5%	60%	-

* All hostels of the university and the office building belong to the high-rise buildings group.

Results of poll show that students and teachers of MGSU treat high-rise buildings up to 25 floors high more tolerantly. These buildings are widespread in Moscow; they are habitual for perception and operation. Other relation to skyscrapers, it alerted and partly negative. Those respondents who wish to live in high-rise residential buildings have specified that buildings have to be in the downtown. Nobody wants to live in the high-rise apartment houses located on the suburb. The reason for that are the psychological and social problems arising at residents of high-rise residential districts. The experts studying influence of the urban environment on the person around the world meet in the conclusions that high-rise housing is a concentration of negative factors.

Residential high-rise buildings increase population density in this quarter. In certain cases it isn't bad. High-rise buildings in the center are occupied by rich people. It is good for the area and it is prestigious for residents. On the megalopolis suburb absolutely other tenor of life.

Apartments in the multi-storey building on the suburb of the city have lower price. They are got by people with other level of prosperity, education and culture. Also to these areas occupy people according to social programs: orphans, needy, immigrants [11]. Comfortable cohabitation requires a certain level of culture of all inhabitants of the house. It most often is impossible. Residents of different social groups form numerous subcultures which are at enmity with each other. Therefore multistoried housing and dense population in suburban

areas negatively influence moral atmosphere of life. Here it isn't necessary to wait for rapprochement and improvement. Hostile faceless environment of panel houses in which there live Russians today, makes a certain impact on their behavioral installations. She forms at them total estrangement and individualism in the worst sense. The environment of skyscrapers doesn't promote communication to people. Residents of multi-storey buildings often don't know even the neighbors in a staircase. The yards in such houses don't perform the main function of space of socialization [12], and serve only as an intermediate zone between the apartment and the street. Reduction of contacts between inhabitants, growth of feeling of the inhabited environment anonymity, leads to growth of household vandalism and crime, in particular among teenagers.

Modern new buildings situated near Moscow are multistoried same buildings in the middle of the huge yards waste grounds. Such building isn't proportional to the person. The more storeys in the building, the more the person feels small and as though "pressed to the earth". Similar "pressure" of skyscrapers, though isn't realized, but can create an additional stress that is expressed usually by feeling of fatigue, irritability and desire to be fenced off from people around. It is difficult to master huge empty spaces around the house psychologically. The microspace of communication makes about 10 m [13]. The space out of these borders remains to strangers and turns into the huge and uncomfortable waste grounds. The dense population provides to the person less than 10% of necessary personal space that causes discomfort, fear and aggression. Everything together it promotes growth of crime and suicide.

Results of poll have shown that accommodation on the top floors of high-rise buildings even in prestigious districts of the city also not too attracts people. The reason for that is care of physical and mental health.

The statistics of diseases shows that at inhabitants above the fifth floor, the frequency diseases of respiratory organs grow. At those who live above the ninth floor this indicator increases several times. Pathogenic bacteria are carried by air which climbs from first floors staircases, mines of elevators. These air inhabitants of the top floors breathe.

Advantage of clean air at height is practically not felt. At many skyscrapers on the top floors of a window don't open. Because of the high wind speed outside the window it is always noisy and is very cold. At a height wind can reach such force that will constitute real danger. The woman, for example, can just not hold a shutter of a window in hands and receive blow by a window frame. It is from the windward. And with leeward side so low pressure that can exhaust the person literally outside.

Need to use the liftleads to reduction of time spent in the fresh air. Children from low houses can walk one. Parents control their behavior through a window. Children from skyscrapers are deprived of such opportunity; they are forbidden to be used the lift independently. Also parents can't control and even see the child from a window of the 20th floor. The elevator creates obstacles for the accompanying adult's child: inconvenience using a carriage, need to control the child during the trip, etc. Statistically children from multi-storey buildings lag behind in physical development the peers living in other conditions. The same treats also health of elderly people, many of which are subject to fears when using the lift.

Accommodation in skyscrapers can cause mental health problems. At height at the person visual touch with the earth is lost. Living on the 40th floor sometimes feels as on the plane. Psychologists also note that inhabitants of the top floors can be subject to height fear – an acrophobia, fear of the closed and opened spaces – claustrophobia and an agoraphobia respectively, besides — aero acrophobia — fear of open spaces at height. If they are summarized with fears which accompany the person at stay underground (for example, in an underground parking) [14], the level of a stress becomes hazardous to health.

Besides a skyscraper inhabitants are very vulnerable at technical malfunctions. The most terrible is the fire. Therefore fire safety of skyscrapers is given especially large number of researches [15 - 17, etc.]. One more feature of skyscrapers is the raised pressure in all pipes. Otherwise not to lift water on the top floors [18]. Because of it breaks of pipes in skyscrapers - the phenomenon constant, quite often fills in on several floors. Hard it is necessary to the inhabitant of a skyscraper and at power outage. Elevators will stop - and the person will be locked in the apartment.

According to poll of Institute of comparative social researches, preferences of city dwellers now on the party of low low-density building [19]. The modern resident prefers to walk in the parks and squares, to see green plantings [20].

The most part of respondents have noted in questionnaires that they would prefer to live in houses from 3 or 4 floors. Slightly less respondents have shown willingness to live in seven - or the nine-floor house. At the same time nobody has agreed to acquisition of housing in the 22-storey building, even on condition of fine transport infrastructure in the area. It means that with growth of welfare inhabitants will leave residential districts with skyscrapers and big population density to more comfortable areas. And in multi-storey quarters there will be only outcasts who give nothing to the city but only consume his resources.

Survey conducted within the real research has yielded a bit different results. 51% of respondents (generally teachers and nonresident students) have preferred to live in low areas; 22% - in houses from 5 to 25 floors high; 27% - in the high-rise buildings located in the downtown. About preferences of the last group of respondents already it has been told above.

4 Discussions

Multi-storey and high-rise housing has arisen in the large cities as the answer to land platforms deficiency. People knew about it in Ancient Rome. Gradually multistoried housing became "standard" for a city landscape, and today most of the population on the Earth lives in apartment houses. And since the end of the 19th century as deification of an engineering thought also the first skyscrapers have appeared. Now in the world there is no megalopolis in which there would be no "highest" building.

However single skyscrapers in the downtown and inhabited residential districts on the suburb have absolutely different level of expediency comfort [21].

Esthetics, convenience, comfort, ecology of the majority the Russian multistoried new buildings very low. Increase in density of building leads to such pollution that the territory gradually turns in unsuitable for life not only in respect of comfort, but also from the medical point of view. The more the number of floors in the house and population density, the are higher probability that someone from residents will be an outcast and will damage the lift, will draw at an entrance, etc. And further the condition of housing will only worsen [22]. Faceless, depressive and in many respects the anti-human environment of multistoried residential districts really produces the outcasts and attracts strangers, promotes formation a criminogenic situation. In the West have faced it long ago. For example, in the USA in 1972 in the city of St. Louis have demolished a housing estate of Pruitt-Aygou. In the beginning it was considered as a modernism masterpiece, but has gradually turned into the most real ghetto. The American authorities then have understood that such social housing brings more problems, than advantage. In Russia there is a similar situation now.

The cities have to develop so that the quality of the urban environment increased, the soil and air were cleaned, population density and traffic flow decreased, access to social infrastructure was facilitated. Houses at most up to 3 floors high, without elevators, with underground parking is the most optimum at the price and comfort option. 1-2-3-storey

lodges with the second inhabited floor, with profitable business (shop, a pothouse, etc.) on the first floor, with delivery of rooms on the attic and a warehouse in the cellar are correspond to traditions of the European and Russian architecture [23]. And domination of multistoried boxes over surrounding space puts the psychological pressure upon consciousness an individual.

However to find the land plots for low housing construction it is real only on suburbs of the cities. And it is most important "minus" of such building with which also other problems – transport try to keep step, infrastructure and also social – everything that is connected with absence in suburban settlements of kindergartens, schools and hospitals with polyclinics [24]. Therefore resettlement people to remote suburbs doesn't solve a problem. It leads only to increase in number of motor transport and number of accidents, growth of CO₂ emissions and increase in level of a stress from constant trips and traffic to the place of study, work of rest and back [25]. The remoteness from social infrastructure is one of the most important reasons which forces able-bodied population to be flown down to the cities with their uncomfortable multistoried housing and dense population, to raise and raise children in these conditions, to form a certain social environment, to accumulate psychological and medical problems.

5 Conclusions

Equations should be centred and should be numbered with the number on the right-hand side. High-rise housing construction is on the advanced positions in the construction sphere today. Existence of skyscrapers distinguishes any modern city, and ability to build them speaks about high development of construction technologies, intellectual designers' opportunities, readiness of the corresponding material and technical resources.

Skyscrapers (especially buildings of the mixed use) are rational in essence [26]. In them a large number of people on a small ground can be placed. It allows to save agricultural grounds from building and reduces the energy consumption and emissions of carbon in the environment connected with pendular migration (i.e. with moving of people, say, from suburbs, by work and back).

Skyscraper is also the integral element of prestige for the city and even the whole country. It is no wonder what is under 85% of the largest skyscrapers in the world constructing in Asia where special attention is paid to this aspect.

However high-rise housing construction in Russia has the restrictions. Most of the population in the cities are immigrants from rural areas in the first or second generation. They have still very strong requirement of a unification with the nature, requirement of close direct contacts with relatives, friends. Most of citizens tolerantly belong to buildings up to 25 floors. Skyscrapers cause the alerted relation. As the residence most of people prefer low areas or skyscrapers in the downtown. Multi-storey residential quarters in the suburbs with sad appearance are least attractive to housing. At the same time they remain popular because of low cost. The uncomfortable yards, long distances from the house to the house and to places of social infrastructure negatively influence mental and social wellbeing of inhabitants. People come to the big city behind happy life, but get depression and isolation. High-rise construction in Russia doesn't promote the solution of social problems though has indisputable pluses before low building. Rather it lays the foundation for new problems which consequences are coming to us.

References

1. Russian State Standard SNiP 2.07.01-89*

2. URL : http://www.statdata.ru/nasel_regions
3. URL : <http://capitalgroup.ru/press/media/2012/7879>
4. I. Ptuhina, T. Spiridonova, T. Musorina, S. Kanyukova, A. Rezvaia, MATEC Web of Conferences, **53**, 01049 (2016)
5. A.Y. Barkovskaya, M.P. Nazarova, Izvestiya VolGTU, **16 (5)**, 37-42 (2014)
6. N. V. Anisimov, E. A. Ivashechkina, Molodoy uchenyy, **11**, 1840-1842 (2015)
7. C. Ingraham, The Washington Post, March 18 (2016)
8. E. Pafka - <http://hdl.handle.net/11343/52749>
9. A. Yugov, A. Tymoshko, Modern industrial and civil construction, **10(4)**, 217–224 (2014)
10. A. Zaiter, High-Rise Building Definition, Development, and Use. *High-Rise Security and Fire Life Safety* (Elsevier Inc., 2009)
11. N. Petković-Grozdanović, B. Stoiljković1, M. Shubenkov, MATEC Web of Conferences, **73**, 06001 (2016)
12. A.A. Jamaludin, H. Hussein, K. Md. Tahir, MATEC Web of Conferences, **66**, 00098 (2016)
13. Z. Ivanova, I. Pryadko, MATEC Web of Conferences, **106**, 01012 (2017)
14. E. Romanova, Procedia Engineering, **165**, 1176 – 1183 (2016)
15. V. Pershakov, A. Bieliatynskiy, I. Popovych, K. Lysnytska, V. Krashenninnikov, MATEC Web of Conferences, **73**, 01001 (2016)
16. X. Zhixiang, T. Yong, Procedia Engineering, **45**, 705 – 709 (2012)
17. M. Qianlia , G. Weib, Procedia Engineering, **45**, 685 – 689 (2012)
18. URL : <http://tinybop.com/Tinybop-EL07-Skyscrapers-Handbook-EN.pdf>
19. A.S. Kurbatova URL : http://terraplan.ru/pdf/ecoreal_17_razvitie.pdf
20. I.I. Akulova, Gradostroitelstvo. Infrastruktura. Kommunikacii, **1(1)**, 21-28 (2015)
21. D. Korolchenko, V. Kholshchevnikov, MATEC Web of Conferences, **106**, 01038 (2017)
22. I.P. Pryadko, International Journal of Applied Engineering Research, **21**, 42147-42152 (2015)
23. V. Kasyanov, O. Landysheva, MATEC Web of Conferences, **86**, 04060 (2016)
24. A. Babayeva, E. Zakablukovskiy, T. Smetanina, N. Shmeleva, N. Shilovskaia, MATEC Web of Conferences, **106**, 01003 (2017)
25. URL : https://www.econstor.eu/ERSA2014_01736.pdf
26. S Abd-Wahab, A.I. Che-Ani, A. Sairi, N.M. Tawil, M. Abd-Razak, MATEC Web of Conferences, **66**, 00103 (2016)