A draft decision on the issue of urban expansion of a densely populated city

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Abstract. The problem of urbanization turns up from the urban compaction. This project is designed to solve this problem in the densely populated city of Tokyo, the population of which is more than 13 million people today. The project of a new neighborhood in the city takes into account social, economic, environmental and geographical characteristics of the Land of the Rising Sun. The project provides one to combine the idea of a universal city with high population density in a small territory. The territory involves a residential area, an industrial area and an agricultural area simultaneously that promotes well-balanced relations between man and nature. The purpose of the survey is to show that it is necessary and possible to use a new strategy of city planning and building, relevant for large, densely populated cities, to make cities more comfortable and economical. The quarter is located on a man-made island in Tokyo Bay. The quarter was built after burning solid household waste without causing damage to the environment by a waste burning plant located on this island to the north. In addition, the plant produces gravel material for creating an artificial island. Besides, it yields surplus electric energy that is fed into the power grid of Tokyo.

1. Introduction
Cities around the world occupy 3% of the earth surface, make up half of the human population, use 75% of resources and make up 2/3 of all energy consumption and greenhouse gas emissions. Proven assessment implies the fact that the world urban population is estimated to be 70% by 2050 [1]. This is especially true for many countries with high population density: India, China, Japan. In India, the scientists Patel [2], Kumar [3] dealt with urbanization issues. This problem has become especially urgent by the growing number of mega-cities [4-9]. The researchers propose to solve this problem by taking advantage of underground space in their studies [10-13].

Smart cities have become a tendency of development for many of the largest cities in the world. Many scientists share this way since they are concerned with the problems involved rapid urbanization [14-21].

Modern cities usually consist of separate buildings: cottages, multi-storeyed buildings, interconnected by traffic and building services. The disadvantage of such cities is considerable expenses of construction of infrastructures (roads, traffic interchanges, metro, utilities, etc.). In large cities, these costs are already from four to five times more than the building cost of the houses themselves. The daily population and goods flow in vast numbers stands for many tens of kilometers of over ground and underground transport. The length of the extremely expensive Moscow metro is more than 650 km. A comfortable living of citizens finishes already outside their apartment or a
cottage. People spend hours on daily trips around the city. Bad weather, summer heat and winter cold, snow, icy spots, hypothermia, insects, heavy traffic, etc. lead to diseases, injuries and deaths of tens of thousands of people every year. Thus, cities with detached buildings are not only physically, but also become obsolete and dangerous to live in. Therefore, there is a necessity to arrange self-organized, self-sufficient areas.

2. Tokyo Residential Area Project
The authors locate this quarter on an artificial island in Tokyo Bay, which was built after burning hard domestic waste in an environmentally sound manner by a combustion plant located on this island to the north and which is more, producing gravel material for creating an artificial island and generating excess electricity that it is fed into the power grid of Tokyo. The quarter can hold up to 10 thousand people.

![Diagram of the quarter projected](image)

**Figure 1.** Diagram of the quarter projected: 0 – Garden Square, 1 - Spin Tower, 2 - Square Tower, 3 - Blade Tower, 4 - Shalom Tower, 5 - Agri Tower, 6 - Edge Tower.

The diagram of the projected quarter is presented in Figure 1. The authors position 24 buildings on this island. They are divided into 6 groups. They include 4 model buildings. All of them are integrated into a vehicle system consisting of 3 encircling highways connected by 8 radial lines. Since Japan is situated in the zone of high seismicity, measures were taken to stabilize all building constructions in space. All buildings are united in a single bell-shaped dome net by means of communications between end joints placed at different levels to create more stiffness. They are joined to separate deeply tied to ground understructures, which take the maximum load during an earthquake or storm. These pipes have a diameter of 3 meters and are made of light environmentally friendly polymer materials capable
of sustaining both large wind (storm) and seismic loads. Moreover, these pipes in this project are used as public transport systems, which freely allow using escalators without going outside to get into another building. Therefore, utility systems such as electrics, plumbing, and fanning/perflation are placed there. Each skyscraper of this project has not only technological, but also psychological purpose, since each form of the building emphasizes not only the futuristic visuals of this quarter, but also the whole city of Tokyo inhabitants’ perception in the human-urban system.

Models of the buildings constructed are depicted in Figure 2, Figure 3 and Figure 4. The skyscrapers No. 1 in Figure 2a, 1307 m. high are designed as residential. In addition, schools, nursery schools as well as shopping and leisure centers are located on the ground floors. The skyscrapers No. 2 in Figure 2b, 900 m. high are designed as office blocks. There are administration offices of government institutions are placed on the ground floors. In the skyscrapers No. 3 in Figure 2c, 700 m. high, emergency services are located on the ground floors, cultural and religious organizations are located on the middle floors, sports and recreational centres are on the upper floors.

Skyscrapers No. 4 in Figures 3a, 4b, 500 m. high are designed as residential buildings. Schools, nursery schools, as well as shopping and entertainment centers are located on their ground floors. The skyscrapers No. 5 in Figures 3b, 4a are designed for the needs of the agricultural sector. In these buildings they grow small agricultural crops such as tomatoes, cucumbers, dill, parsley and others without need for plant pollination. The height of these skyscrapers is 370 meters, the width is 620 meters. The skyscrapers No. 6 in Figures 3c, 4c 305 m. high are designed for the needs of the industrial sector. The buildings are designed for the production and assembly of technology-packed electronics, such as computers, medical facilities, microcomputers and other sophisticated equipment.

In all buildings of the quarter there are underground car parkings with individual outlets for recharging an electric car. For walking between floors, a system of multi-level high-speed lifts is provided. Hardscaping and economical LED-based lighting along the roads were installed using the basic principles of ergonomics.
Figure 3. Models of buildings of the quarter designed: a - Shalom Tower, b - Agri Tower, c - Edge Tower.

Figure 4. Models of buildings of the quarter projected after rendering.

3. Conclusion
Creating convenient and comfortable living conditions for people in large cities is a serious need recently. The population density of Tokyo is more than 6,000 people per square meter.

Thus, the construction of this area will help to solve many problems of densely populated Tokyo, such as socialization and self-provision. The district project will help improve the infrastructure of the city of Tokyo and provide comfortable living conditions for citizens.

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