



Application of Innovative Standards of Green Construction in Tatarstan on the Example of Kazan

Tatiana Zakirova and Enver Asadullin

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March 29, 2020

APPLICATION OF INNOVATIVE STANDARDS OF “GREEN” CONSTRUCTION IN TATARSTAN ON THE EXAMPLE OF KAZAN

T.R. Zakirova

Kazan State University of Architecture and Engineering

E.Z. Asadullin

Kazan cooperative Institute

Kazan, Russia, env60@yandex.ru

Abstract. The article discusses the prospects for the application of innovative technologies in the theory and practice of urban development on the example of Kazan. Market relations in recent decades in our country have created a number of critical problems in modern urban planning - curtailing long-term planning, reducing environmental control in the city and its environs, etc. It is necessary to turn to the Healthy Cities initiative of the European regional office of the World Health Organization. The first steps in this direction have already been taken in Kazan. This is the project of the new business center of the Republic of Tatarstan “SMART City Kazan” and the first “smart home” built in the territory of Technopolis Khimgrad. In Kazan, there are prerequisites for the implementation of eco-city design methods. These are vast water areas of the Volga and Kazanka rivers, the banks of which are not yet fully developed. This is a large area in the city center, which freed up after moving beyond the city limits of the old airport. It will also be useful for Kazan to replace the decorative glass false facades often found on brick buildings after reconstruction with vertical “solar walls” of air heat technology.

Keywords: green architecture, green building, energy conservation, alternative energy sources.

1 Introduction

In connection with the emergence of acute environmental problems in modern urban planning in the 1970s, the popularization of the movement for a healthy lifestyle and a clean environment began, the first private houses using alternative energy sources appeared. Gradually, in the 1970s and 80s, an understanding of the importance of energy efficiency was formed at the state level and the standards of “green” or green building were introduced. In the 1990s, the BREEAM standard [1] was introduced in the UK; in 1992, the Energy Star program [2] in the United States was launched. In 1999, the first meeting of the World Green Building Council was organized with the participation of

eight countries: Australia, the United Kingdom, Spain, Canada, the United Arab Emirates, Russia, the United States and Japan.

Green building standards, as well as the common term “green architecture”, are aimed at moving from the traditional design and construction of buildings, structures and cities to sustainable, which includes safety and favorable human conditions, limiting the negative impact on the environment, taking into account future interests generations. The implementation of these principles is closely connected with the use of the latest achievements of science and technology.

The term "green" architecture itself appeared in the 80s. XX century and includes not only architecture with an integrated natural component, but also energy-efficient, economical, environmental, ergonomic architecture. Thus, the "green" architecture is created through the interaction of engineering, landscape and architectural solutions and should be considered in their entirety [3-8].

The principle of conservation of energy. This implies a design and construction in which the heat consumption, for both heating and cooling, is minimal.

The principle of "cooperation" with the sun. It involves the use of solar energy as the main source of light and heat.

The principle of reducing the volume of new construction. The less new buildings are built and the more old buildings are used, or at least the materials of old buildings for the construction of new ones, the better, as this reduces environmental pollution.

The principle of respect for the inhabitant. The building does not exist to sell it, it is a place where people live, a place where they live, study, work. For all its spaciousness, the building should be focused on each visitor individually.

The principle of respect for the place. An architectural object should not withstand its environment, it should harmoniously fit into it. Particular attention should be paid to staging the building in the natural environment - architecture should not be hostile to the living world, as it is created for humans.

Principle of integrity. Means that all of the above principles should work interconnected with each other.

These principles are implemented through the introduction of a natural component in the structure of the building, energy-saving measures, as well as the compositional solution of the building in terms and volume. Several dozen buildings have already been built in Russia using LEED [9] and BREEAM standards: these are retail, residential buildings and sports facilities. Laws No. 111730-5- FZ “On energy saving and increasing energy efficiency” [10] and No. 384-FZ “Technical regulation on the safety of buildings and structures” [11] were adopted.

Currently, Russia has developed and used national certification of green building. These are GOST and relevant national standards [10, 11].

2 Materials and Methods

2.1 Green construction in Kazan

Kazan does not stand aside from eco-construction, but has actively joined in this process. In 2010, in Kazan on the territory of the technopolis "Khimgrad", Kazan Uprising, 100, the first energy-efficient house in Russia was built. (fig.1) "Green House" is a one-story 4-apartment building. As the material of the walls, glued beam made of coniferous wood with a thickness of 240 mm with insulation with basalt fiberboards with a thickness of 70 mm and facing with a false beam was used. Such walls retain heat 5-6 times better than masonry. When roof insulation is used, a heater with a thickness of 200 mm is used; the base is made with polystyrene foam with a thickness of 100 mm, for a floor - a heater with a thickness of 50 mm. At the entrance to the house, there is a thermal vestibule and a second door [12].

Energy-saving windows - double-glazed windows with triple glazing and inert gas filling with argon. The supply and exhaust ventilation in the house is organized using a recuperator, as well as with a reversible system heat exchanger. The recuperator efficiency is 75-90%. The energy "hearts" of the house are two heat pumps. For the needs of hot water supply, a heat pump with a capacity of 3.5 kW was used, for the needs of heating, a reversible (allowing the same unit to both cool and heat) heat pump with a capacity of 11.5 kW. Both heat pumps draw geothermal heat from five wells 50 meters deep. The pump picks up heat from the ground, accumulates it and heats the water to a temperature of 60 degrees, after which the water is supplied to the heat supply system. The heat collector on the roof of the house complements this system and can increase the temperature of water to 70-75 degrees.

A 2.5 kW solar battery with an inverter (220-volt converter) saves energy. Inside the house and for its external lighting, only LED lamps are used. The light sensors are turned on and off by motion sensors. The water supply system of the house is equipped with modern water purification systems.



Fig 1. Energy-efficient house in the territory of the technopolis "Himgrad" Kazan city ul. Vosstaniya, 100

March 17, 2014 in Kazan, the start was given to the construction of a new energy-efficient house in Kazan on Khalturina Street (fig.2) [13]. When laying capsules with highly effective materials in the foundation of the house, the President of the Republic of Tatarstan Rustam Minnikhanov noted that, "today we are setting the standards for what we will build houses in the future. Since 2000, thanks to the introduced energy and resource saving programs, the share of energy consumption in the gross national product

of Tatarstan has decreased by 50%, but compared to world standards, the region consumes 2-2.5 times more energy resources”.

Energy consumption in a new house is 60% less than standard values. This is achieved with a weather regulation system, ventilation with a heat recuperator, a geothermal heat pump based on soil heat exchangers, energy-efficient glazing and heat insulation of walls, LED lighting system, the use of solar panels and apartment-based adjustment of energy supply parameters. Hot water will also be heated in the house using two heating circuits. The first is a vacuum helium solar heater mounted on the roof of a technical room. Water will be heated in this way even in winter. Then, heating the water accumulated in the tanks will go at the expense of a gas wall-mounted boiler. As a result, experts believe that the cost of hot water will be 35% lower than when it is produced in a centralized way. The house also provides emergency power from solar photovoltaic panels, and LED lamps are used to illuminate the yard. There will also be LEDs at the entrance, but with light and movement sensors.



Fig 1. The project of a residential building on Khalturina str., 2, Kazan

Another interesting project implemented in the Republic of Tatarstan is SMART City Kazan [14]. The implementation project of SMART City Kazan arose in 2009 from the idea of building the Kazan International Center for Exhibitions and Conferences. In 2011, the idea grew into the concept of creating a new urban space in which international business, services and the latest technologies would be developed.

SMART City Kazan is the new business center of the Republic of Tatarstan, which is located on an area of 650 hectares, in the Laishevsky district of the Republic of Tatarstan, 15 km from the center of Kazan, near the Kazan International Airport and will be connected to the center by the Aero express intermodal transport line, and also the P239 highway and the access road to the village of Stolbische. SMART City Kazan will receive modern infrastructure at the international level, which includes four zones: 1 - public and business center, 2 - public and educational zone, 3 park zone, 4 economic zone. The users of the new business center will be export insurance and financial

companies, business service outsourcing centers, scientific and research centers and government organizations, and the International Exhibition and Conference Center [15].

The main developer of the master plan is AJM Planning & Urban Design Group, the largest developer of general plans for large infrastructure projects in Malaysia. The main architect of the project "Smart City Kazan" Norlisa Hashim. Kazan design organization OAO "Tatinvestgrazhdanproekt" acts as a technical partner for the general plan. The project involves drawing on Siemens' experience in implementing similar projects in the development of technical support for infrastructure and energy-saving technologies in smart cities. One of the demonstration projects of Siemens is the city of Masdar City (Abu Dhabi, UAE). Large Russian and international financial institutions will work with Tatarstan as financial consultants regarding the creation and management of the project.

On July 5, 2012, as part of the meeting of the President of the Republic of Tatarstan, Rustam Minnikhanov, with representatives of the Malaysian consortium (AMANAH Capital Group, Straits Consulting Engineers) and Siemens, the first concept of the Smart City Kazan project was presented [16]. AJM Planning and Urban Design Group attracted KSASU students to finalize the concept of the master plan for the SMART City Kazan project.

The population of Smart City Kazan in accordance with the project concept will be about 60 thousand people, and jobs - 39 thousand. It is supposed to place offices of large international and Tatarstan companies here [17].

On August 14, 2012, the Corporation for Development of the Republic of Tatarstan was established. The objectives of the new organization were to interact with external investors to create the necessary infrastructure and conditions for the implementation of investment projects in real estate. The Development Corporation was created on the initiative of the Investment Development Agency of the Republic of Tatarstan.

On September 24, 2012, in Singapore, between the "Development Corporation of the Republic of Tatarstan" and the Malaysian consortium, a contract was signed to carry out design work on the development of the master plan for the "Smart City Kazan" project [18]. This was held as part of the VII Russian-Singapore Business Forum. The President of the Republic of Tatarstan Rustam Minnikhanov praised the work done by the consortium and emphasized that SMART City Kazan is a unique project as a whole for Russia and should be a priority for Tatarstan. The best achievements of world practice should be used in the work on the Project.



Fig 1. Project (perspective) “SMART City Kazan”

The official start of the “SMART City Kazan2 project took place on April 30, 2013 as part of the III annual AIM investment forum in Dubai, the ceremony was attended by the President of the Republic of Tatarstan Rustam Minnikhanov and the UAE Vice President, Prime Minister Sheikh Mohammed bin Rashed Al Maktoum [19]. They noted that companies from the UAE could become potential investors of the SMART City Kazan project, at the same time a Memorandum of Understanding was signed between the Development Corporation of the Republic of Tatarstan and Cisco in the field of developing an intelligent master plan for the SMART City Kazan project. In addition, agreements on investment of the project for 400 billion rubles were signed between Sberbank of the Russian Federation and the Agency for Investment Development of the Republic of Tatarstan. The American company Kronos Energy Solutions, engaged in green technologies, will participate in the creation of the innovative transport system SMART City Kazan. This company discussed the prospects of launching electric vehicles in Kazan in test mode.

On September 10, 2013, the Smart City Kazan project won the Russian stage of the FIABCI Prix d'Excellence global competition, one of the most prestigious global real estate competitions, which is a tool to identify the best international experience and attract the interest of international investors in local markets and their successful operators (fig.3). Winning the FIABCI Prix d'Excellence competition provides access to an international audience to promote their projects and companies through the FIABCI network, whose branches work in more than 60 countries and bring together specialists from more than 120 national professional associations of various specialists operating in the real estate market: developers, realtors, lawyers, appraisers, architects.

The project, which won the FIABCI Prix d'Excellence competition, embodies excellence in all the real estate sectors involved in its creation and offers humanity the best option to meet its needs. This option takes into account environmental qualities,

encourages the functionality of aesthetics, the size of the project, the use of “smart” technologies.

On October 2, 2013, the construction of the International Investment Technopolis SMART City Kazan was launched within the framework of the V International Economic Summit of Russia and the Organization of Islamic Cooperation (OIC) countries (KazanSummit 2013). Four nuclei were laid at the base of the future city, which symbolize the main zones of the International Investment Technopolis (MIT) SMART City Kazan: a scientific and educational zone, a social and business center, a special economic zone, a park zone. These zones are defined as the main economic growth points of the republic and are implemented on the site of the investment Technopolis. At the opening ceremony, the President of the Republic of Tatarstan emphasized that a master plan, city planning had already been made, negotiations with investors were held. Investment agreements on the implementation of SMART City Kazan have been signed. The total amount of attracted investments is about 1 billion US dollars.

The Singapore Company Radiance Hospitality Group implements three projects at the technopolis site - the University of Management and Hospitality, the hotel and office center and the apart-hotel. A consortium of investment companies from the Middle East, the Tatarstan Gulf Investment Company (TGIC), is an investor in the Kazan Expo International Center for Exhibitions and Conferences, as well as an interregional shopping center and business park. The international oil and gas services company TGT Oil and Gas Services is investing US \$11 million in the establishment of its own engineering center on the territory of SMART City Kazan and is moving its headquarters in Dubai to SMART City Kazan.

As part of the ceremony, the operator of the SMART City Kazan project was awarded a certificate from the Green Building Council (RuGBC) [13]. The certification confirms that the Development Corporation of the Republic of Tatarstan is a member of the Non-Profit Partnership for Assistance in the Creation and Implementation of Environmental Construction Norms and Rules, and uses the principles and ideas of green construction in the implementation of the SMART City Kazan project. SMART City Kazan will become an “experimental” site for green construction. Buildings will be built on the territory of the city using advanced energy-efficient solutions, mainly from renewable materials that consume a minimum of energy. The experimental status of the SMART City Kazan technopolis as an experimental site for the implementation of green standards in construction is enshrined in the orders of the Cabinet of Ministers of the Republic of Tatarstan.

In Kazan, there are good prerequisites for the implementation of methods for designing eco-city: these are vast water areas of the Volga and Kazan rivers, the flooded banks of which are not fully developed, which makes it possible to increase green areas and reduce the amount of asphalt and concrete [20]. These are large areas in the center, which were freed up after removing the airport and industrial zones from the city limits. All this makes it possible to create high-tech, occupying a small area, multi-story agricultural complexes in the vacated areas. The vertical farm is a high-rise automated greenhouse in which plantings will be located on different tiers of the building. Such

farms will be located in an urban environment, which will significantly reduce not only transportation costs, but also ensure freshness and quality of products.

Vertical farms themselves create all the necessary conditions not only for growing crops or plants, but also for livestock [21]. In addition, vertical farms will be able to process carbon dioxide, purify process water, and generate electricity from biofuels and much more [22-27]. Vertical farms turn cities into centers for growing agricultural products, allowing the use of urban conditions previously unsuitable for agricultural needs. Typical features of the use of vertical farms is:

- use of solar and wind energy, which ensures energy independence;
- the use of autonomous systems for the collection and purification of water, the processing of carbon dioxide (CO₂) and waste, the use of biomass energy;
- flexible construction of buildings and the ability to install additional modules;
- The possibility of harvesting year-round, the products are environmentally friendly (without herbicides, pesticides or fertilizers). Cases of crop failure due to adverse weather conditions, drought are excluded;
- Excludes the use of agricultural machinery, transportation costs, and thereby the emission of harmful substances into the atmosphere.

In addition, it is possible to create new jobs in the city. It will also be useful for Kazan to replace glass decorative false facades, which have recently been used in the reconstruction of brick public buildings, with “solar walls” such as the Solarwall system [21-24].

Well, of course, it is necessary to actively develop the experience of the first “smart” residential building built in Kazan in the construction of the city. All this will reduce the impact of waste and prevent environmental pollution, create an energy-efficient, economical, ecological, ergonomic environment through the interaction of engineering, landscape and architectural solutions [28-32].

3 Conclusion

In conclusion, it can be noted that because of green construction, Kazan will become a “smart”, socially attractive, modern city, contributing to the economic growth of the entire region, with effective urban management. All this will contribute to the qualitative growth of social standards of living standards of the population of Kazan and at the same time will reduce the share of energy consumption in the gross national product and improve the environmental situation in the city.

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