Climate Change and Eco-Anthropocentric Approach to Architectural and Urban Planning

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Abstract. Ahumane and environmentally friendly urban environment is akeypriority of the modern age. An eco-anthropocentric approach to design engineering is legislated by many European countries. Federal Building Code (BauGB, Germany) commits municipalities to analyze urban development plans and identify unintended hazardous environmental consequences for urban residents. This approach assumes special importance in the context of mounting climate changes. Europe’s design practices are eco-anthropocentric; they take account of the climate change and behavioural patterns of urban residents. In this article, eco-anthropocentric climate-conscious architectural solutions, developed by M. Eichner, the co-author, are presented. He develops his architectural projects with account for local specificities, eco-friendly construction materials, and traditional models of dwellings. His projects are both social and ecological; they absorb the best civil engineering solutions; their impact on the biosphere and the global climate is also assessed. The findings of the self-examination, performed by the NRU MGSU students, majoring in architecture, are also contributed to the article. Students realize the importance of climate-conscious design, although they do not think there is a growing demand for projects of this kind in Russia; urban residents do not realize the importance of climate-conscious construction. The co-authors make a conclusion that both local and global patterns of influence, produced by buildings on the environment as a result of their consumption of materials, water and energy, vary from country to country, and so does the demand for climate-conscious architecture. However, given the climate change across the world, architectural and urban planning design will put emphasis on a combination of ecological and humane factors.

1. Introduction
An eco-safe and climate-saving social city means “smart science” and urban planning/design policy. An eco-anthropocentric approach to design, focused on the top-priority preservation of the biosphere and development of a comfortable human environment, must take account of the natural environment and its condition, climate change processes, life satisfaction, health of residents, and rational consumption of resources. Cities are the main drivers of power consumption and greenhouse gas emissions as sources of man-induced climate changes. The research projects have proven that the anthropogenic nature of climate changes is understood differently across the world [1]. EU constituent states express deepest concern about the adverse consequences of the global climate change process. This concern is maximal in Portugal (51%), and Spain (48%), and minimal in Russia (14%), Poland...
The sense of personal responsibility for the mitigation of climate change consequences is maximal in France and Switzerland (with the average score of 7 on a scale of 1 - 10), and minimal in the Czech Republic and Russia (the average score of both is below 4) [2].

The resolution of climate change problems pursues two principal objectives: preservation of the biosphere and preservation of humankind, or development of a biosphere compatible, safe and comfortable environment. These objectives merge together in the legislation of the EU countries, government documents, and urban design practice. Assimilation of energy efficient technologies, conversion to renewable sources of energy, green building and architecture represent milestones on the path towards an ecologically and socially comfortable living environment. At the same time, a socially comfortable environment contemplates active involvement of citizens in its formation, coupled with their civil responsibility and political maturity.

The mission of this article is to analyze implemented eco-anthropocentric urban planning and architectural design projects. The research methods, used to draft this article, include (1) document analysis, (2) sociological surveys. The document analysis method was employed to analyze the ADAPT programme, Covenant of Mayors and Mayors Adapt initiatives launched by the European Union, the Federal Building Code (BauGB), documents issued by the German Sustainable Building Council (DGNB), etc. On top of the above, the co-authors launched a sociological survey among 3d-year architecture students of the National Research Moscow State University of Civil Engineering.

2. Research Background

Today numerous research projects are focused on climate change. The problem has turned so relevant that many countries perform meticulous studies of the climate change processes, global warming; they try to identify drivers of climatic transformations [3]. Research projects draw attention to the fact that the influence, produced by climate change on urban development, has developed into an essential problem. The urban environment is particularly sensitive to minor meteorological, hydrological and ecological processes; therefore, urban climate observation centres register any influence intensity in each urban district. An article, written by Swedish researchers, covers the operation of Urban SIS, a climate observation service that offers simulated historic and future-oriented data on particular European cities at 1 km resolution [4]. In the meantime, researchers attempt to develop alternatives to global climate change. Their projects focus on mitigating climate change consequences and urban climate management through architectural and urban design [5]. A present-day city is to transform into a low-carbon environment [6, 7]. Many researchers believe that prevention of global warming and overheating in cities, neutralization of CO$_2$ emissions may require such actions as the design and development of green areas. Urban landscapes full of numerous green areas may influence isles of urban heat and cool down sources of overheating [8, 9].

Urban architecture is an essential driver that may bothboost or diminish negative effects of climate change. Architectural design must take account of local climate change patterns. It is understood that climate-related processes vary even within one region; they depend on urban landscapes, uplands, rivers, lakes or sea coasts. For example, according to the researchers based in the USA and China, climate-focused strategies of energy efficient design and operation of buildings require in-depth understanding of the local climate. Climate zones are essential for construction rules and regulations, and vital for the application of construction technologies. The study of climate zones by designers of buildings will improve their energy efficiency and temperature conditions inside them. The co-authors offer a novel climate zoning method based on a double-level classification that applies to the passive design of buildings performed with account for climate data (degree days, relative humidity, solar radiation and wind speed) [10].

Researchers from China are engaged in numerous research projects focused on the architectural design of bioclimatic structures designated for different climate zones and environments. A research group has analyzed the basic components of 30-year long-term meteorological variables. The Typical Principal Component Year (TPCY) was identified for Harbin, Beijing, Shanghai, Kunming and Hong Kong, which represent five principal architectural and climate zones of China: severe cold, cold, hot...
summer and cold winter, mild climate (hot summer and warm winter). Later the researchers developed a power consumption model for typical air-conditioned office buildings in Harbin, Beijing, Shanghai, Kunming, and Hong Kong.[11, 12]. The eco-anthropocentric approach to urban design is the only way out of the present-day situation. A comfortable and safe environment requires comprehensive research projects to tackle anthropological (humanitarian) and ecological problems with a view to environmental protection. This work is being performed at the Hague University of Applied Science, the Netherlands. In particular, researchers Helen Kopnina and Andreea Cocis relate the condition of the environment to eco-centric and anthropocentric human values.[13,14]. In Russia, integrated research into atmosphere degradation processes is performed by a group of researchers headed by V.A. Ilyichev, academician of the Russian Academy of Architecture and Construction Sciences (RAACS). Pilot models of the urban biosphere development, based on the calculation of humanitarian balances of the bio-techno sphere, are introduced into practical architectural and urban design of several Russian cities and towns.[15,16].

3. Results
Social factors and the humanitarian focus of urban development strategies play the leading part both in resisting global warming and mitigating climate change consequences. Over the last ten years, the European urban development has pursued the strategy for climate protection and adaptation of urban areas to climatic conditions, as well as social modernization and satisfaction of urban residents’ demand for urban development.

In 2008, an agreement was made by mayors of European cities (“Covenant of Mayors”) to support the actions taken by the local authorities in respect of climate change and power engineering. In 2013, the European Commission adopted the EU strategy for adaptation to climate change (ADAPT). An European platform supports Europe in its effort to adapt to climate change (Climate-ADAPT); it helps users to access and share data on current and projected climate-related hazards and generates public awareness of the adaptation process and the measures to be taken. In March 2014, the Mayors Adapt initiative focused on adaptation to climate change was launched. The majority of the European cities have joined this initiative. They share information on climate change effects, technologies and problem-solving actions, launch joint events aimed at mitigation of climate change consequences. The mission of APART member mayors is to better support local activities, to provide a platform for more intensive interaction between the cities, and to implement joint actions. The territorial EU agenda (Territorial Agenda of the European Union) urges for better coordination between the EU cities considered as problematic urban areas[17].

Since 1976, environmental protection has been the governing principle of the public building legislation incorporated into the Federal Building Code (BauGB): “If construction plans, urban rehabilitation actions, urban development actions or urban restructuring actions produce an adverse impact on personal lives of residents, living or working in a particular district, the municipality must draft proposals for prevention or mitigation of adverse consequences and discuss them with any concerned persons”[18]. The Building Planning Law focuses on municipalities that have the right to perform land zoning within their borders with account for land types, land use intensity, sustainability and social compatibility pursuant to the Building Use Decree (BauNVO). Climate protection and adaptation to climate change consequences are among the present-day top-priority development principles assumed by German cities. The principles are to ensure “worthful environmental protection, protection of natural fundamentals of human living, and promotion of protection and adaptation to the climate, particularly in terms of urban development”[18]. The German Sustainable Building Council (DGNB) has developed fundamental provisions that govern climate-neutral buildings and urban development areas. Methodological fundamentals of climate-neutral buildings and urban districts, developed by the German Sustainable Building Council (DGNB), will make a substantial contribution to practical de-carbonization of urban areas through 2050. The methodology comprises versatile social factors facilitating reduction of CO2 emissions [19].
Urban planners and architects call for a thorough research into climate zones in particular territories, as well as the urban residents’ demand for a comfortable environment. Given these two prerequisites, the following basic principles of climate-conscious construction have been formulated:

Energy conservation. This principle means using natural lighting and heat in design and construction, as well as minimizing the use of electric energy for indoor heating or cooling during the whole life cycle. Today this methodology is called “a passive home”. In Germany, the most recent definition of a passive home is based on “Decree on energy-saving thermal protection and energy-saving engineering equipment for buildings” (EnEV). This Decree complies with the fundamental legal principles of the energy saving law (EnEG).

The Passive House Institute, Germany, has developed standards applicable to passive houses, and presently, this institution is engaged in certifying construction materials and components, recommended for passive houses. The Passive House Institute has developed a detailed algorithm entitled Passive House Planning Package (PHPP). A village of townhouses, that had 28 three-storied items, was commissioned in Moscow (Kurkino, Russia); the floor area of each item is 200 m². Village designers implemented numerous innovative construction technologies and solutions there.

“Solarcooperation” means using the sun as the main source of light and heat. For example, the architecture of southern Europe traditionally rests on principles of reasonable use of sunlight and natural heat. The Atica project developed by Velux, a company based in Spain, is a curious example. A specialized electronic system controls the indoor climate by automatically closing and opening windows, blinds and roller blinds, by turning on and off cooling and heating systems pursuant to pre-set parameters, including temperature, humidity, time of day and season.

Reduction of new construction. This principle focuses on the use of old buildings and structures or their debris in the process of construction of new buildings, provided that their rehabilitation, environmentalization and effective planning are duly performed.

Respect for residents. This principle encourages construction of socially responsible residential buildings that meet the requirements of residents or future employees that will occupy office buildings. Any architect, who commences a new design project, should not treat is as a formality. Rather, he or she should virtually place himself or herself into the building that is being designed.

Respect for a place. This principle can be interpreted as respect for the biosphere, the environment, the landscape, the climate, in other worlds, for everything provided by nature in the amount that prevents any destruction. The respect for a place is possible if an architect, a builder, landlords refrain from exploiting the biosphere, but if they honour the balances of the bio-technosphere [20].

Principle of integrity. Since the above principles are inter-related, they should be complied with at the same time.

Human lives and safe existence of nature depend on how comfortable cities and buildings are for humans and the biosphere, how attentively they treat each other.

Buildings that comply with the above-listed principles have been designed by professor M. Eichner, a German architect, consultant specializing in Green Building and Sustainable Urban Design, who co-authors this article. Currently, M. Eichner is working at an architectural project (a group of single-family houses) entitled Chehoff. The project will be implemented in the environs of St. Petersburg (Figure 1). Environmentally safe construction materials will be used in this project (Alligator and TM Kaimaneco-friendly products). Architect creed: «A modern house should not only be convenient for humans, but also as close to nature as possible». 
Another challenging project, developed by professor M. Eichner, was an eco-friendly Leather Home. The architect used processed leather capable of adapting to severe weather conditions of the Russian north, reducing heat losses, protecting from strong winds, reflecting the sunlight and improving the living standards of residents. Thanks to its compact and climate-adjustable design, as well as the framework made of timber, which is the principal construction material of this project, it is appreciated as a contribution into the eco-friendly modern architecture (Figure 2).

Ten architectural projects, developed by students of the Moscow Institute of Architecture (MARKHI) under the supervision of professor M. Eichner, were submitted to the Kolomensky Kremlin reconstruction contest. Students presented their eco-anthropocentric approach to design: they demonstrated their eco-friendly technologies coupled with the care for the historic heritage. One of ten student design projects is presented in Figure 3.
In context of the problem under discussion, there arises a question whether Russian students, or future architects, are ready to work at architectural projects that promote climate protection, whether they realize the true danger of global warming and the role of architecture in the climate change process, or, alternatively, whether few architects are ready to develop projects of this kind. A self-examination project was launched among NRU MGSU students majoring in architecture. The project represented an online questionnaire survey conducted in April 2020. Thirty 3d-year students participated in the poll.

The overwhelming majority of the respondents (93.3%) gave a positive answer to the question “Does architecture influence the environment and the climate change process?” (Figure 4). Students are aware of the problem; they realize the importance of climate protection in design.

![Figure 3. Project designer Loschilova Anna.](image)

![Figure 4. Answers to the question “Does architecture influence the environment and the climate change process?”](image)

Besides, students believe that Russian architectural projects fail to meet ecological rules and regulations (83.3% of the respondents); mere13.3% of the respondents gave no answer to this question (Figure4). Students think that this problem enjoys little attention in Russia, as no compliance with green standards is binding here and no green certification is obligatory. 64, 3% of the respondents try to contribute, at least, some eco-friendly (climate-conscious) elements into their projects, wherever they find it possible (Figure5).
Do you use climate protection elements in your training projects?

| Percent | Answer                                  |
|---------|-----------------------------------------|
| 21.40%  | Yes, I take them into account            |
| 42.90%  | I take them into account partially       |
| 35.70%  |                                        |

Figure 5. Answers to the question “Do you use climate protection elements in your training projects?”

Students realize that climate-conscious design is only feasible in case there is some demand for it. There is no demand of this kind in Russia, as far as the collective consciousness (including the one of the government authorities and construction businesses) is concerned.

4. Conclusion

Therefore, we can make a statement that the eco-anthropocentric approach to architectural and urban planning design is a primary need of the modern age. Research suggests that the understanding of this problem varies from country to country. Acting together at the level of legislation, management, and practice, EU countries take extensive action to adapt cities and construction processes to new climatic conditions. “Green building” standards set hydrocarbon gas emission limits applicable to buildings and structures; eco-friendly construction is supported by the state; ecologically sustainable projects take priority over other ones; developers and purchasers generate cash flows. Russia does not realize the nature of this need, and “green building” standards are not binding there.

There are two solutions to this problem: on the one hand, the cost of design and construction of “eco-houses” must be reduced, production of eco-friendly construction materials needs support, developers and purchasers of eco-friendly housing need encouragement and financial benefits; on the other hand, collective consciousness needs to be changed, public awareness must be generated, and the extent of gravity and irreversibility of climate change/global warming consequences shall be explained. Not only should people feel personal responsibility, but they should also realize that their personal choice can reverse the trend. According to the international team of researchers based in Brazil, China, USA, Mexico, Germany, and Saudi Arabia, “education is key to promotion of ecological sustainability” [20]. Climate-focused education must be integrated into the higher education context across the world [21]. Future architects and builders must have eco-friendly design skills; they must know how to make decisions guided by their social and personal responsibility for any adverse environment and climate-related processes. This research was carried out under the BECK (Integrating education with consumer behaviour relevant to energy efficiency and climate change at the Universities of Russia, Sri Lanka and Bangladesh) project funded with support from the European Commission. The findings and opinions reported in this paper reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained in it.

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