

Campus: University or a Modern Urban Structure?

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Abstract Modern cities face a range of problems, such as the need to redevelop inefficiently used former industrial territories, traffic congestion in cities, air, water and soil pollution and the disappearance of cities' last remaining natural areas. These issues require rethinking methods for the redevelopment and renovation of city districts. The campus model for the formation of sustainable territorial units in a city is set to replace conventional zoning (residential area, industrial area, city centre, recreational area). In campus structures, like in university campuses, everything is grouped together: residential and recreational facilities, schools and workplaces. Meanwhile, the environment, with elements of an individually-branded design code, is an area for likeminded people (residents of the campus) to interact. New social and economic models, as well as new global ideas, contribute to the appearance of new campus city blocks and micro- and macro-structures that are comparable to smart cities – the showcases of contemporary intellectual communities. In such urban areas, nature also plays a different role: it ceases to be a passive background, a means of featureless landscaping based on standard principles. The present research offers a description, analysis and classification of campus urban structures, based on the preliminary study of historical types of landscape organization in university campuses. Based on comparative historical analysis and experimental modeling, it distinguishes five types of the architectural and landscape organization of campuses: the enclosed model, the communicative model, the podium model, the nature-oriented model and the nature-equivalent model. In nature-equivalent campuses, nature becomes the main participant in the environment. Such urban structures become natural elements themselves, as they become parts of the ecosystem: environmentally safe, sustainable and

self-regulating components of the natural and anthropogenic global landscape. The material laid out in the present research is of practical importance for students of architecture and campus designers.

Keywords Eco-Urbanism, Green Urban Planning, Campus Model, Nature-Equivalent Model

1. Introduction

The term 'campus' is quite popular among contemporary architects: business campuses, healthcare campuses, corporate campuses, scientific campuses, high-tech campuses, greenfield campuses, etc. Until recently, only educational territories set up in the style of American universities (where students' residential and educational facilities were concentrated in one area) were called campuses. The popularity of the term allows speaking of the emergence of a campus model of urban planning. Contemporary designers of various campuses borrowed features like pedestrian links and the accessibility of all necessary, functional facilities from university campuses. Nowadays, numerous people are willing to forgo everyday driving; walking and cycling are popular; working in the same area where one lives is also a modern trend [1]. The scale of campuses contributes to their popularity as well: they are cities in miniature which lets them turn into experimental areas. Campuses bring the development of the knowledge economy – the trend that increases the importance of innovations, knowledge and education for the economy – into the mainstream [2]. Universities compete for best students; therefore, the appearance of the campus is of great importance [3, 4].

Attempts to construct smart cities may also be attributed to the campus model which tests new social and environmental approaches to sustainable design [5]. Design is carried out at the ecosystem level, and the experimental territory – an architectural and urban-planning complex or a so-called campus – becomes a ‘unit’ of the environment. Campus has acquired the meanings of ‘microcity’, ‘micropolis’, ‘eco-city’ and others. Attempts to search for new forms of co-existence of architecture and nature – Masdar smart city, Vincent Callebaut's concept of the Lilypad floating ecopolis, Songdo in South Korea, PlanIT Valley in Portugal — are called eco-cities. However, these concepts may be also called examples of campuses – scaled-down models of cities. Originally, the word ‘campus’ referred only to schemes of universities, but now it acquires a broader meaning. From the Apple corporate campus, the Smithsonian cultural campus in Washington DC, the Sberbank campus on the Istra river, to diplomatic, healthcare, military, sport or religious campuses, this word means a separate territory with its own ‘rules’ and may be considered an experimental model for new urban-planning ideas to be tested.

The campus approach is becoming more and more visible in contemporary urban-planning projects: different urban functions exist side by side and intersect with each other more often [6]; residential areas and business, social life, educational and recreational facilities are concentrated together in multi-functional campuses [7]. Numerous studies of campuses highlight this trend; among the most prominent are the works by [1, 3, 8, 9, 10, 11, 12, 13]. A number of articles and monographs focus on campuses in Russia as well, and they include works by [14, 15, 16, 17, 18, 19]. The unquestionable value of nature in the modern urban environment and the importance of environmental approaches to the design of urban structures make it necessary to study the landscape organization of campuses. This aspect still remains out of sight, not studied specifically. The present research attempts to trace the ways in which campuses and natural environments historically interacted, and to propose a possible design methodology for campus structures with regard to landscape architecture.

2. Materials and Methods

The methodology is based on systematizing a wide range of data and examples from global practice. About seventy existing and planned projects that can be attributed to campus-style urban planning are considered. The present study interprets the campus broadly – not as a university territory but a closed territorial complex with a specific charter and main functional profile. The study aimed to develop recommendations for designing a campus urban planning model that ensures the sustainable development of the city. The research hypothesis is based

on the existence of the so-called nature-equivalent campus which can be considered as an experimental urban planning model aimed at testing the possibilities of maximum assimilation of the campus with the natural environment. The nature-equivalent campus type is defined by analyzing historical patterns of campus interaction with the natural environment.

The subject of the research is the ways of creating equivalence to nature in campus urban planning systems at the morphological, technological or symbolic levels. The general methodological approach of the research is to ‘isolate’ signs of nature equivalence from the object of research (campuses). The main landscape-ecological orientation of the research requires isolating an arsenal of specific techniques that are effective from the point of view of environmental equivalence and are applicable for architectural and urban planning. For this, a selection and study of creative concepts-theories on the interaction of architecture and nature was carried out. Analogy methods allowed creating various spatial models-schemes of the interaction of campuses with the natural environment.

2.1. The University Campus — Past and Present

The term ‘campus’, which means ‘field’ in Latin, originally appeared in the middle of the 18th century. At this time, the first American universities were located outside of cities in idyllic natural landscapes, implementing the principles laid down during the Enlightenment [1]. In 1774, Princeton University was the first to be called a campus. The aspiration of the American political and intellectual elite to build a civilization from scratch in the late 18th and in the 19th century led to the formation of a new university model and to the integration of educational institutions into the environment. Originally, campuses contained only educational and residential elements, but later they also acquired recreational infrastructure. Harvard, the first university in the New World, had a building with the entire infrastructure needed for students' life and education. Unlike European universities, the U-shaped building was open to residents of the town [20]. In the University of Virginia concept developed by American president Thomas Jefferson (1817), the recreational area can also function as an educational space. Educational and residential pavilions were designed along both sides of a long lawn open for all, which was symbolic of democracy. An important distinction of Jefferson's campus was that the library became the dominant element of the structure, taking the place of the medieval church.

The most active construction of student dormitories – colleges – took place in the 1970s. Various scholars associate it with the 1968 students' unrest in Paris, which ‘expelled’ universities from the city. In response to the unrest, French authorities launched a large-scale program to relocate universities to the suburbs. British universities were relocated as well. Hebbert [1], M. Huyghe and J. Van

den Bussche [21] note an advantage of an urban campus: based on the example of Ghent University, they demonstrate how the intertwining of city and university buildings increases interaction between the former and the latter and strengthens the academic community. The network of Ghent University clusters which are distributed around the whole city transforms the surrounding urban space in accordance with the logic of the university.

A university campus is a detached university territory which includes educational buildings, dormitories, infrastructural facilities, sport facilities, and landscaped open spaces. Today, these elements also include facilities for the new social functions of universities, laboratory buildings and research facilities, as universities serve as centers of intellectual activity in society and of advanced scientific research in which the university's former students, postgraduate students and professors, as well as invited members of the scientific community, are involved. A recently trend is campuses returning to cities and to closer interaction with their surroundings, which promotes increased intellectual discourse within the campus and communication with the business community [1].

2.2. The Campus Model and Its Landscape Types

Having defined the campus and how its contemporary development is envisioned by most scholars, the present research turns to the historical laws of the landscape development of university campuses. The historical retrospective begins before the construction of American universities, as the world's first universities appeared back in the 11th century – for instance, the University of Bologna, Italy's oldest university, was founded in 1088.

2.2.1. Enclosed Model

The world's first universities were set up like monasteries [9], in fact, the university as we know it today began to form in Mediterranean monasteries. The first public universities and university ensembles appeared in Europe in the 14th century. Constructed in 1368, the Collegio di Spagna complex ushered in a new typology based on the organization of monasteries. This type can be called the *enclosed* model of landscape organization – the inner yard of the university, the ‘cloister’, was surrounded by a two-story building with arcades, a fact which is attributable to the isolation and elitism of the scientific community of that time [20]. An architectural and landscape organization similar to that in Europe also exists in Russian practice – the building of the Imperial Academy of Arts in Saint Petersburg (1757). The corridors of the

Academy surround four ‘well courtyards’ while the windows of some lecture halls look out onto the round central courtyard which is a recreational area. The Slavic Greek Latin Academy, built on the premises of Zaikonospassky Monastery (1687), can be also considered an example of the enclosed model in Russia.

Architect Henry Ives Cobb designed a series of cloisters for the University of Chicago (1890), stressing the educational and disciplinary nature of the design. As a military uniform distinguishes its wearer in a crowd, it served to distinguish the university in the midst of urban chaos [20]. The cloister model was always in high demand, and was used often in university campuses. Residential areas for students called colleges, similar to the oldest British colleges, were set aside as part of the campus of Princeton University in the USA. The design of the Princeton colleges included internal recreational areas – courtyards – where the everyday life of students took place. There are several cloisters in the educational building of the University of Essex, each symbolizing a specific square or park in the town [19]. However, the aspiration to create a closed community is out of line with modern universities' aspiration to ‘go to the people’ – a desire not only to ‘endow’ society with knowledge but also to try out conceptions and theoretical constructs in practice [20]. Courtyards can also be found in the buildings of contemporary universities. The building of the faculties of Law and Political Science of the Luigi Einaudi University in Turin, designed by Sir Norman Foster (2013), consists of two buildings connected by a flat triangular roof and a large round atrium courtyard.

2.2.2. Communicative Model

Historically, England's Oxford and Cambridge Universities were made up of several colleges with enclosed cloisters, connected to each other by shared green corridors – malls [15]. Thus the *communicative* model of the landscape organization of university campuses appeared; in this model, landscaped public areas ‘flow’ into one another and provide for the communication of students, professors and city residents. In 1873, Charles Sprague Sargent, first director of Harvard University's botanical garden, invited Frederick Law Olmsted to the university. At that time, Olmsted was working on the design of urban territories and park areas. He designed the landscaping project for the Harvard botanical gardens, including the Arnold Arboretum, to include rare exotic bushes and trees. He turned the landscaped areas into a park system uniting Cambridge and Boston, and this park was called Boston's Emerald Necklace.



Figure 1. Enclosed Model: 1 — Cambridge; 2 — Oxford; 3 — Imperial Academy of Arts in Saint Petersburg; 4 — Luigi Einaudi University; 5 — Apple campus; 6 — Moscow Architecture Institute



Figure 2. Communicative Model: 1 — Harvard; 2 — Jefferson University; 3 — University of Illinois; 4 — Bienvenüe campus; 5 — Boston's Emerald Necklace; 6 — Aalto University; 7 — Massachusetts Institute of Technology; 8 — University of Granada

In the contemporary educational process, it is not classrooms and lecture halls that play a central role, but, rather, spaces for informal communication where students can exchange information, share their work and discuss what they read or heard [22]. Open recreational areas promote a synergetic effect which appears when different disciplines are able to unite. Specialists from the British studio OS+A have presented their design for the Campus International School, which is characterized by an open floor plan with zones for classrooms, cafeterias and cafes, and recreational areas are also equipped for the study of specific disciplines. Streamlined forms and curves are used to form functional areas. Such design is to help students' life become less formalized, promote students' development and ultimately make them more successful.

2.2.3. Podium Model

The architectural and landscape organization of university campuses was originally based on landscape areas framed by building lines. However, in the 20th century, buildings began to be placed independently from each other, and campus space acquired new scales and a new type of landscape organization. Today, the main focus is shifted to the building. There is no specific name of this type of arrangement, but it can be expressed using the word 'podium', since the park landscape can be seen as a podium for the university's main building. A. Hajrasouliha [13] calls this type of organization a 'cohesive campus'. Since World War Two, students grew in number dramatically; therefore, designers of new projects plan high-rise structures instead of previously horizontal links between

buildings [10]. Moscow State University campus (1956, architects Boris Iofan and Lev Rudnev) is based on this principle: the university's main building is the primary, dominant feature of Moscow. Like other administrative and residential high-rises, it is designed as a building with an enclosed utility infrastructure (a cultural centre, libraries with reading halls, a post office, telegraph office, cafeterias, shops, salons and barber shops, centers for public services, a clinic, and a sports centre with a 25-metre swimming pool). Thus, having entered the building on the first of September, a student can (theoretically) live and study there without leaving the building until the end of the academic year.

In 1965, architect Walter Netsch made a monumental building with lecture halls and auditoria the central element of the University of Illinois in Chicago complex. Its key elements are an open internal amphitheatre for ten thousand people with roof access (an esplanade and several ramps) and with exedrae on the roof. These spaces in the building were designed as places for informal interaction between students and lecturers [10]. Another campus which can be considered an example of the podium model is that of the National Autonomous University of Mexico built in 1949–1952. The rectorate and library buildings are decorated with frescoes by famous Mexican muralists. The main stadium for the 1968 Olympic Games, which Diego Rivera helped decorate, is located on the campus territory.

2.2.4. Nature-Oriented Model

This trend originated in the Enlightenment, when education was conducted in parks, and then continued during the establishment of American universities implementing the ideals of the era. In the 19th century, universities “experimented with new settings that were suburban or rural, in pastoral landscapes that they called campuses” [1]. At the time, anti-urbanism was widespread: it was thought that an idealized natural landscape contributed to the educational process. Alexander Pushkin's alma mater, the Lyceum in Tsarskoye Selo, is a park itself, completely ‘dissolved’ in nature. Novosibirsk's Akademgorodok melds with nature in the same way [23]. Pushkin stresses the spirit of freedom and free nature in the Lyceum. The Lyceum Gardens are, first and foremost, a world of freedom, carefree attitude, friendship and love but also a world of solitary reading and reflection [24]. Such landscape and architectural organization is also apparent in the Massachusetts Institute of Technology (1916). The buildings of the new campus are integrated into the urban environment and are arranged along the river. The campus of the Far Eastern Federal University on the Russky Island (2009) creates a semicircle around the bay; the buildings gradually change in scale as they approach the water. The campus's main landmark is the 1300-meter embankment along the Ajax Bay. The pier is designed to dock small boats, motorboats and yachts.

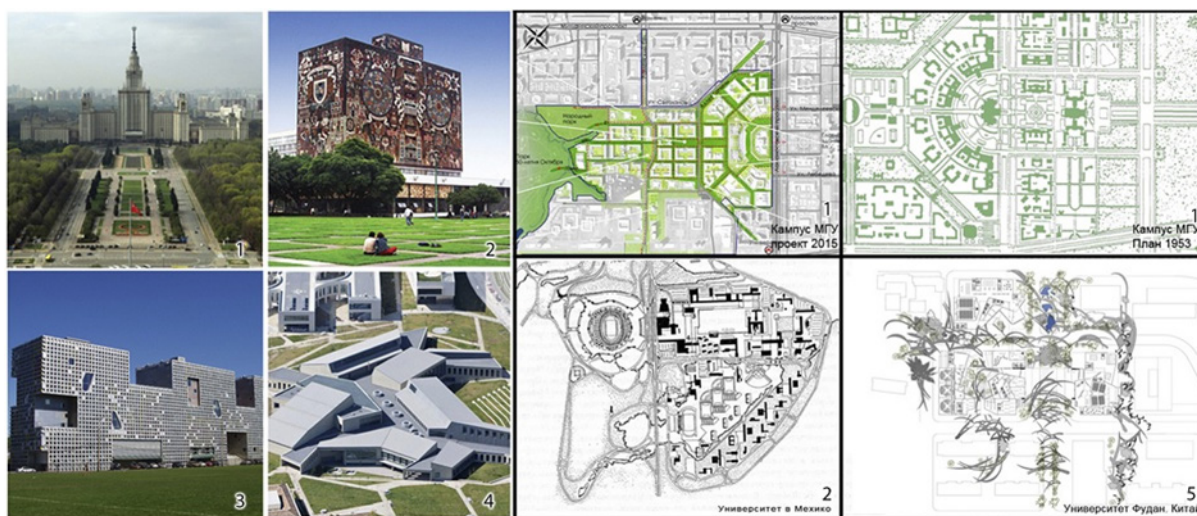


Figure 3. Podium Model: 1 — Moscow State University; 2 — National Autonomous University of Mexico; 3 — Massachusetts Institute of Technology (USA); 4 — Cruz y Ortiz university (Spain); 5 — Fudan University (China)



Figure 4. *Nature-Oriented Model:* 1 — the University of Nottingham; 2 — Akademgorodok; 3 — University of Haifa; 4 — Far Eastern Federal University; 5 — Hanoi University (Vietnam); 6 — Lyceum in Tsarskoye Selo (Russia); 7 — Massachusetts Institute of Technology

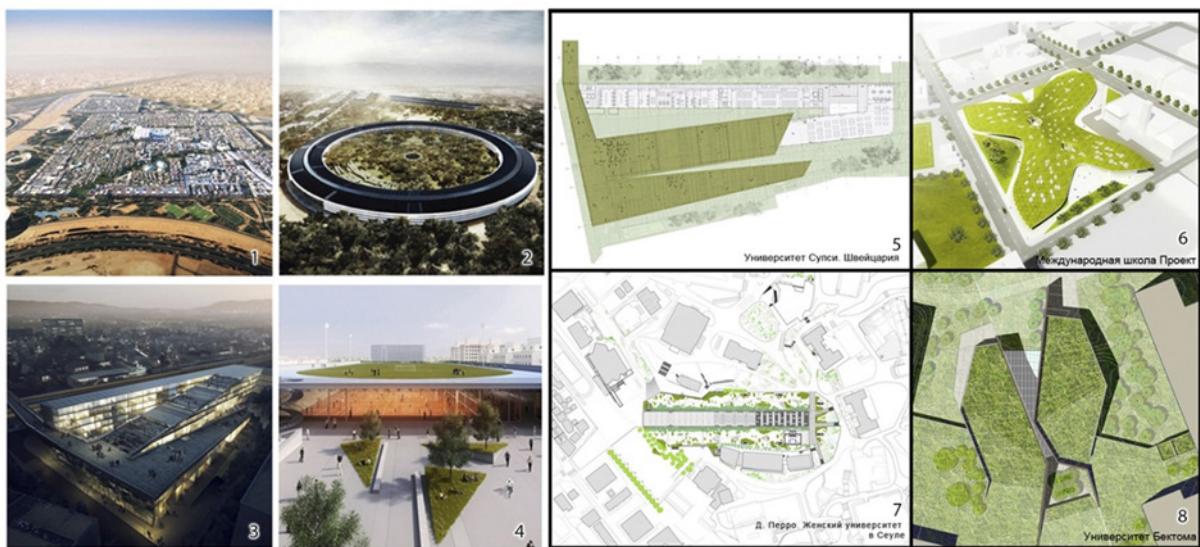


Figure 5. *Nature-Equivalent Model:* 1 — Masdar City; 2 — Apple campus; 3 — SUPSI; 4 — Brazilian Federal University of Medical Sciences; 5 — SUPSI; 6 — International School; 7 — Seoul Women's University; 8 — Beckton University

2.2.5. Nature-Equivalent Model

Contemporary philosophy and the concept of sustainable development persistently works to implement architecture based on the ‘Green Code’ [25]: university campuses “should give us a glimpse into a sustainable future” [26]. The architecture of a contemporary campus aims to be equivalent to natural environment in terms of its properties; it is a part of the ecosystem and does not disturb the natural balance [27]. University campuses are a unique sociocultural environment for the practical implementation of the concept of sustainable development [28]. This is possible thanks to cutting-edge recycling technologies (wastewater treatment, waste processing, energy-saving technologies, and reproduction of nature inside buildings and on green roofs) [5]. The Apple campus in Masdar City

(UAE), designed by Sir Norman Foster, implements these principles. The nature-equivalent model of campus architecture fits in with the vision of the university as a centre of intellectual activity and an engine driving scientific discovery in the sphere of modern eco-technologies [17]. The authors of the present research propose that a campus be considered to be nature-equivalent if it implements the ideas of green architecture: the physical and psychological properties of the space should be similar to those found in nature [29].

Amir Hajrasouliha writes that “a well-designed ‘American campus’ is defined as a mixed, dense, well-connected, well-structured, inhabited, green, and urbanized campus” [13]. However, he considers the simultaneous application of these qualities to be

contradictory: compact campuses in urbanized environments cannot be as green as suburban campuses with low population density. Hajrasouliha suggests that the issue of landscaping dense urban campuses be resolved via interaction with nearby city parks and green areas. At the same time, there is an understanding that this problem can be solved by the quality of the dense urbanized environment itself, which can be achieved with 'landscaping' means integrated into architecture (green roofs, facades, podia, stylobates, interior green spaces). The concept of the campus of the largest private women's university in Seoul proposed the development of a green roof for the building, which visually 'sinks' under the ground (architect Dominique Perrault). With a huge number of facilities, this structure which occupies an area on par with that of a small university campus is dissolved in nature [15].

2.3. Design Methods for Nature-Equivalent Campuses

Numerous contemporary studies examined the issue of the integration of nature and architecture [30]. The campus urban-planning system, like campuses in general, can be of several spatial types when considered in relation to the urban environment and urban space where they have emerged and are developing: urban and suburban; reconstructed and newly-built; dispersed and local; microcampus, minicampus, megacampus; block, single-centre, multi-centre, linear, with quarters, multi-zone, multi-core, hybrid [15]. Other classifications or development schemes for campuses may be also identified. An 'archipelago' campus unites various facilities within one campus; an 'island' campus limits student interaction to a specific campus area; a 'boulevard' campus connects all of its facilities with a single axis; in a 'hub' campus, there is a dominant facility and a virtual education network [21].

All of the historical models (types) of the landscape organization of campuses are used nowadays, but the nature-equivalent campus is becoming the most pertinent, contemporary type. Naturally, the question arises of how to design it. The process of creating a nature-equivalent urban planning system can be presented from a number of different angles, including environmental, aesthetic, legal, urban planning, social, economic and technological aspects. Considering the main tendencies for the design of nature-equivalent campus systems, it is possible to propose some major, principled approaches to their design. The main design principle is the principle of nature equivalence, which is comprised of):

- *Sustainability* — development of an artificial environment able to produce its own energy and water resources, and that has the capacity for processing, recycling and secondary use of resources and waste;
- *Maximum assimilation with the natural environment* — preservation and restoration of the most important natural components which define the place's 'spirit'

and the area's environmental characteristics; the prioritization of natural components for the establishment of sustainable ecological elements in an artificial environment;

- *Adaptivity* — continuity of processes of qualitative renewal of the environment with convertible and mobile elements which create shading and visual transparency in the environment; establishment of environmentally-friendly conditions in the human habitat, visual and spatial harmonisation of the campus;
- *Semanticity* — interpretation of the components of 'second nature', i.e. culture, and of symbolic connections (which form on the campus) with the natural environment and natural mythology of the place; symbolic and visual interpretation of natural forms in the campus structure;
- *Priority of pedestrian areas* — a contemporary approach to the urban planning of pedestrian links and new types of transportation systems (bicycles, electric vehicles, etc.).

The principles above listed should be implemented holistically as the aspects that they cover are interconnected and mutually reinforcing. The authors of the present research propose three approaches to the design of experimental urban planning models for campuses:

*The natural formation method (techniques: underground urbanism, territory reproduction, appropriation of natural forms, and optical dematerialization).

One of the main principles of creating nature-equivalent campus structures is embedding these into their natural landscape that they even dissolve fully into it. Natural formation of buildings can contribute to this goal; they can be formed in the shape of hills, dunes and 'cut-outs' in the natural landscape, with the active use of green roofs that imitate natural terrain. EuropaCity multilevel cultural and sports campus (architect Bjarke Ingels, Paris) can serve as an example of this model. The campus was supposed to occupy 80 ha and recessed under the ground, with a wide accessible green roof that dissolves in the surrounding landscape and a classical radial ring structure.

*The natural functioning method (techniques: energy saving, alternative energy production, filtering, closed cycle, and self-organization over time).

The Clichy-Batignolles residential campus in Paris was designed in a former industrial area of the city. It is organized around the Martin Luther King Park laid down in the former place of rail track and warehouses. To promote and protect biodiversity, about 500 species of plants were planted. An artificial pond also serves as a habitat for waterfowl, and a rainwater collection system is used to water the plants. Clichy-Batignolles has everything necessary for the functioning of a self-sustaining urban campus: residential buildings for different groups of residents, offices, schools, shops and a cultural space.

















SYMBOL	FORM	FUNCTION
 sacralisation of landscape elements	 appropriation of natural forms	 alternative energy production
 introduction	 territory reproduction	 energy saving
 sacralizing nature	 underground urbanism	 filtering
 materialisation of a legend	 blurred volume	 self-organisation over time
 symbolisation of natural forms	 optical dematerialisation	 closed cycle
		 certification

Figure 6. Design methods for nature-equivalent campuses

*The natural meaning method (techniques: sacralization of landscape elements, materialization of a legend, introduction, and symbolization of natural forms).

The Qatar National Convention Centre is a multifunctional facility developed by Japanese architect Arata Isozaki (2011). A gigantic, curved steel structure which calls to mind the branches of a holy tree gives the building its unique shape; the tree symbolizes three pillars: knowledge, research and social development. The building received the LEED Golden certification in 2013.

Architecture filled with natural symbolism is not just an artistic style or an architectural concept rooted in ancient history. First and foremost, it represents the new ethics of relations between human and nature [31].

3. Conclusions

The long history of campuses is the history of universities. Certain tendencies are quite recent: “campuses are not just for universities”, “the campus is trying to come back to the city from the suburbs”, “in the campus, nature is reproduced at three levels: at the level of form, the level of function and the level of meaning”. The main subject matter of the present research can be reduced to these three assertions. Campus urban planning structures which have adopted the advantages of university campuses universally offer a model of a multifunctional space for residence, education and work. The debate about the advantages of a pastoral, suburban greenfield campus continues; however, most scholars prefer the urban model, where all functions maximally intersect, and there is nothing to interfere with interaction between participants involved in the creative process. The lack of areas with a natural environment in urban campuses, however, does not prevent the creation of a truly ‘natural’ environment where

the building itself becomes nature, imitating the form of the landscape, striving for the sustainability and environmental friendliness of its lifecycle and serving as a metaphor for nature.

The study describes a hypothetical model of a ‘nature-equivalent campus’ – an urban planning model in the design of which the architects are aware of the priority role of nature in the formation of the living environment. A trend that can be called a ‘campus approach’ to city design is also identified. The demand of society and new economic foundations dictate the construction of ‘mixed’ urban development complexes where work, study and living will be in the vicinity of a comfortable natural and social environment where ‘pendulum’ migration from residential areas to the city’s business center or industrial zone is not required. Remote work, new business formats and new types of intelligent production make the campus a popular form of urban planning environment. This statement has become especially relevant against the backdrop of changes associated with the Covid-19 pandemic. Being a self-sufficient and comfortable environment at the same time, the campus urban planning system allows its inhabitants to limit external contacts.

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The authors would like to declare no potential conflict of interest.

Notes on Contribution

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Vera Pavlova has a PhD in Architecture (Moscow Architectural Institute, 1998) and is a professor of the Landscape Architecture department of the Moscow Architectural Institute. Her research interests are the theory, history, and methodology of landscape architecture.

Image Sources

Figure 1-5: Author: V. Goloshubin.

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