University campus in the strategy of functional and effective architectural morphogenesis

Z F Nizamutdinova¹, N D Oreshkin¹ and A A Kriukova¹

¹Irkutsk National Research Technical University, Institute of architecture, construction and design, department of drawing, painting, fundamentals of design and historical and cultural heritage, 83 Lermontov str., Irkutsk, 664074, Russia

E-mail: zfartit@gmail.com

Abstract. This article presents an analysis of the structure of foreign and russian university campuses to find the most optimal organizational factors. The analysis criteria are the geographical location of campuses, transport and pedestrian schemes, the percentage of landscaping and university rating indicators. As a result of the work, the most effective aspects of the campus organization are emphasized for further application of the acquired knowledge in practice.

Universities are a huge part of the urban environment. Due to the intersection of dozens of functions, universities consist of complexes of buildings, transport networks with complex functional intersections, and Park spaces, which in turn forms a scientific and educational urban environment—“campuses”. Such a territory includes buildings that perform different but related functions, such as providing training, housing students, providing sports activities, and others. The close connection of all the buildings on the campus forms a large-scale system that requires a careful design approach to ensure the comfort and efficiency of the complex. At the stage of campus development, problems may arise related to the urban context, the development of existing buildings and the search for new territories for construction, for these reasons, the university campus is not always a single structure, and the main buildings may be located quite far from each other. It is important to understand how this and other issues affect the successful development of the university.

Campus exploration is a relatively new topic for research. There are several classifications of the campus, which can be used to identify the structure of buildings and transport grid and identify common methods for solving problems in the organization of university campuses.

One example is the version of a Professor at the higher school of urban studies named after A. A. Vysokovsky NRU HSE (Moscow), A.A. Vysokovsky and architect A.V. Evsyagina [1], which defines four types of spatial organization of the campus: type 1st—a compact University located in a single building or complex, without dormitories. The number of students at such universities is not growing at all or is growing very slowly. It can be assumed that the transport and pedestrian scheme of this type of campus will coincide with the citywide one. Complex organization in this type is not necessary. This is followed by the 2nd type—the campus, which is a single territory where all the University buildings are concentrated—a purely educational. Academic and laboratory buildings, administrative buildings, student dormitories and faculty housing, sports, cultural and leisure facilities. As a rule, such a device is the most optimal. Walking distance to all buildings on campus saves time and improves the learning process. But it is a competent pedestrian map of the territory that will give this spatial organization of the campus
advantages. The grid of paths should be logical and practical, and the extreme buildings of the campus should have a connection. Type 3rd dispersed university-is formed with the active growth of the institution by adding newly built or existing buildings located in different places of the city. This type of campus organization is most common due to its feasibility. It is quite difficult to organize a large enough unified space within the city limits for the construction of all University buildings. That is why a huge role in the mobility of students is played by the organization of transport routes that allow you to easily get from one part of the university to another. Type 4 is a combined university, where the central territory - the campus - is supplemented by a network of academic buildings and dormitories scattered throughout the city. A striking example of such an organization is MSU in Moscow. In addition to well-organized pedestrian paths on the main campus, it is also necessary to provide transport links between remote parts of the University.

Another classification of campuses is by location in the context of location. Territorial complexes (campuses), as urban development objects United by a common global function, are divided into two groups by their origin: the “Greenfield” campus (that is, being built on a new site) and the reconstructed or integrated into the existing urban fabric. They are of several spatial types, if we consider them in relation to the urban environment and the urban space (urbanized territory) in which they originated and develop. In general, all corporate object complexes can be divided into four types:
- urban dispersed type (a collection of objects dispersed in an urban environment);
- urban local type (separate territorial units);
- suburban (suburban) local, or actually “campus” type (“Greenfield” campus);
- “mix” (spatial “mix” of functions, objects, and spaces in the general space of campuses and urban environments) [2].

Classifications combine campuses into a specific structure that can be used to evaluate their functional productivity. In this article, we analyzed nine University campuses based on the organization of development, transport and pedestrian grids, the number of students and teaching staff, and the amount of landscaping surrounding the main building. The combination of these factors can determine mainly the efficiency and functionality of university campuses.

To begin with, we will provide statistical data on the studied universities. **Table 1.** “Statistical data on universities”. The authors of the table are students of INRTU A. Kriukova (ARb-18-2), N. Oreshkin (ARb-17-2), 2020.

| Logo | Name of the University, year of Foundation | Number of students | Number of teachers |
|------|------------------------------------------|--------------------|--------------------|
| ![TUM](image) | Technical University of Munich (TUM) [3], 1868 | 42 705 | 594 |
| ![UZH](image) | University of Zurich (UZH) [4], 1525 | 26000+ | 5000+ |
| ![UW](image) | University of Vienna (UW) [5], 1365 | 92000+ | 9300+ |
| ![MSU](image) | Moscow State University (MSU) [6], 1755 | 38 150 | 10 784 |
| ![HSE](image) | HSE University (HSE) [7], 1992 | 47 500+ | 7000+ |
In our review, the range of universities is different in scale. The factors influencing the architectural and planning formation of campuses are determined: the volume of buildings, the structure of the pedestrian and transport network (figure 1 and 2), the history of the university's foundation, the number of students and teachers (table 1).

Another factor in the functional efficiency of university campuses is the percentage of landscaping near academic buildings, in particular the main one. We took a radius of 500 meters and calculated the percentage of landscaping in this radius. Figure 1 shows the indicators of landscaping at different levels - this depends primarily on the proximity of park areas and the location of the campus in an urban environment - the largest indicator of landscaping is on the territory of the main building of MSU. This is due to the large park area near the campus and it can be noted that the smallest percentage of landscaping in this radius falls on foreign University campuses.

The further subject of the analysis of campuses was the building structure of each campus, as well as the transport and pedestrian scheme of territories. We analyzed the entire complex of university buildings and displayed the structure in diagrams (figure 2 and 3). To analyze the transport scheme, we used the territory of the main building as a basis [12, 13].
Figure 2. Analysis of the geographical location of campuses”. The authors of the figure are students of INRTU A. Kriukova (ARb-18-2), N. Oreshkin (ARb-17-2), 2020.
Based on the above analysis (figure 2 and 3), we can conclude that all campuses have their own individual organization, both for development and transport directions. Almost all campuses have a fragmented structure, not all academic buildings are concentrated in one place. This is due to the historical context, universities were founded in the historical center of the city, which is why in the future, when expanding university spaces, new buildings had to be erected on vacant places far from the historical campuses. The most complete, however, are the campuses of the University of Vienna, KSUAE and INRTU. Transport schemes illustrate the accessibility of transport, because university campuses are the largest hubs with a large number of flows of people, which is an important factor in the formation of public transport routes and road schemes.

Figure 3. Analysis of the transport and pedestrian scheme of the main campuses. The authors of the figure are students of INRTU A. Kriukova (ARb-18-2), N. Oreshkin (ARb-17-2), 2020.

In conclusion, we can note the combination of functional efficiency factors in some university campuses. Foreign universities have unique historical campuses, so most of them have modern buildings...
outside the central part of the city. For example, the university of Zurich is located in two parts of the city, and the main one is located in the historical part. The second part, the Hönggerberg campus, is quite remote from the city center. All buildings on these two campuses are located as close to each other as possible, which makes communication between them quick and convenient. If the Hönggerberg campus is surrounded by forest, the advantage of the building's location in the historical part is that they are located next to the park. This improves the quality of the environment and relieves the psychological tension of students and teachers during breaks and after the learning process.

Such foreign examples occupy places in international ratings [14]. According to the authoritative Forbes university rating [15], MSU is the second university in Russia. It also has a favorable urban context due to sufficient landscaping. The campus is compact, the main building is unique, it combines not only a large number of educational facilities, but also a complex of dormitories. Other buildings are located within walking distance, with the exception of a few in another part of Moscow on Mokhovaya st. The quality of education is combined with the competent organization of the university space. First in the same ranking is HSE, which has a very fragmented campus, buildings are located in different parts of the city. This is due to the age of the university it was organized in the already densely built-up center of Moscow. INRTU, located at 77th place, is organized as a whole, its urban context is quite successful, despite the non-central urban location. Comparing INRTU with other campuses, we can emphasize a number of advantages. For example, the presence of a park walking area on the territory around the main building, the close location of bus and tram stops, as well as the presence of all student dormitories near the campus, which are within walking distance.

References
[1] Vysokovsky A A and Evsyagina A V 2013 University in the city Notes of the Fatherland (Moscow: HSE University (HSE)) 4(55) pp 193-214
[2] Puchkov M V 2010 Architecture of university complexes (Ekaterinburg: Ural State University) p 170
[3] Technical University of Munich (TUM) Available at: https://www.tum.de
[4] University of Zurich (UZH) Available at: https://www.uzh.ch/de.html
[5] University of Vienna (UW) Available at: https://www.univie.ac.at/
[6] Moscow State University (MSU) Available at: https://www.msu.ru
[7] HSE University (HSE) Available at: https://www.hse.ru
[8] Kazan Federal University (KFU) Available at: https://kpfu.ru/
[9] Kazan State University of Architecture and Engineering Available at: https://www.kgasu.ru/
[10] Irkutsk State University (ISU) Available at: http://isu.ru
[11] Irkutsk National Research Technical University (INRTU) Available at: https://www.istu.edu
[12] Google Earth. Selection of illustrations Available at: https://earth.google.com/
[13] GIS Internet portal. Selection of illustrations Available at: https://2gis.ru/irkutsk
[14] The World University Rankings Available at: https://www.timeshighereducation.com/world-university-rankings/2021
[15] Kazmina I 2020 Universities for the Future Elite: Forbes Top 100 Russian Universities - 2020 Forbes Available at: https://www.forbes.ru/obshchestvo/403369-universitetety-dlya-budushchey-elite-100-luchshih-rossiyskih-vuzov-po-versii-forbes