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Research paper

REUSE OF VACANT OFFICE BUILDINGS: ANALYSIS OF QUANTITATIVE SPATIAL CHARACTERISTICS OF BUILDINGS ACCORDING TO TYPOLOGY

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Abstract

Adaptations, as a group of different interventions, represent an increasingly common approach in the architectural and urban practice of many cities around the world. In certain cases, conversion of an existing building presents a better solution than demolishing the building and constructing a new one on the same site. Given that it often happens that the implementation of conversion projects is interrupted at some stage and the buildings remain out of use, it is important to consider the conditions for a successful conversion. An adequate selection of a new purpose is one of the most crucial steps. This paper will present an analysis of the most significant quantitative spatial characteristics of buildings according to their typology, to establish which typologies are "spatially compatible" and thus determine the appropriate potential new purposes for unused buildings, depending on the purpose for which they were originally built.

Key words: *conversion, building typology, spatial characteristics of buildings*

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1. INTRODUCTION

Due to market instability, unused commercial buildings are a problem that more and more cities around the world are facing. In practice, several ways of solving this problem are applied: the existing building is demolished and a new one is built in its place, the existing building is renovated to be used again for business purposes, or the existing building is converted. It has been observed that, in comparison with the demolition of the existing and the construction of a new building, adaptations, which refer to various ways of building renewal, are increasingly present in architectural practice. The advantages are primarily reflected in the reuse of already used resources, the potentially shorter time required for the building to be put into use, the preservation of the appearance of the environment, and potentially lower initial financial investments.

The quantitative spatial characteristics of buildings have a great influence on the success of the conversion process as a type of building adaptation which includes repurposing. In this context, an analysis is presented based on the relevant literature and case studies from practice in Serbia [1-14], which refers to the spatial characteristics of buildings according to typologies (by purpose). This analysis is important to conclude which new uses are, to the greatest extent, spatially compatible with commercial office buildings.

2. ANALYSIS OF QUANTITATIVE SPATIAL CHARACTERISTICS OF BUILDINGS ACCORDING TO TYPOLOGY

Figures 1-10 show analyses of the basic spatial characteristics of buildings by typology: structural assembly, grid, floor height, depth of the tract, structure and arrangement of interior walls, and number and arrangement of openings. Figure 1 shows an analysis of the basic spatial characteristics of commercial office buildings.

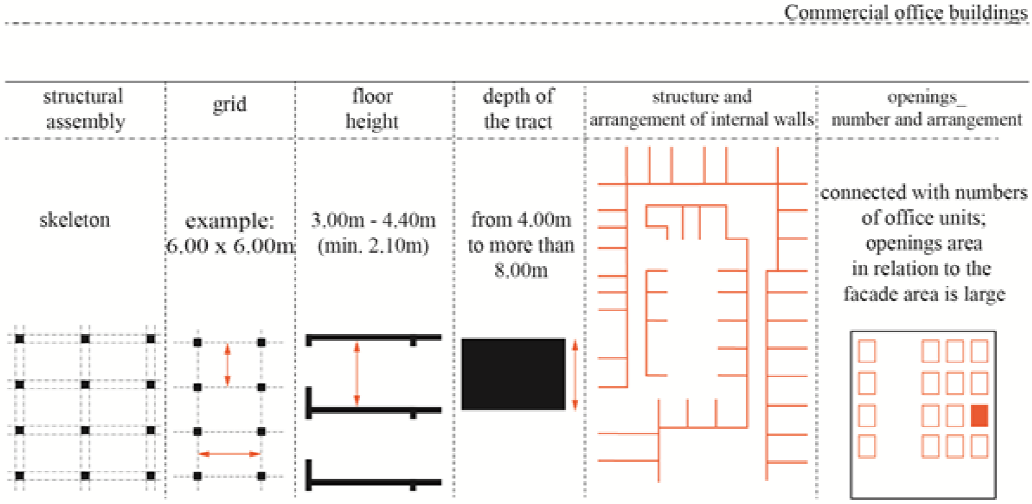

Figure 1. Analysis of the basic spatial characteristics of commercial office buildings, Authors

When it comes to the structural assembly, this type of building is dominated by a skeleton system, which, in the context of conversion, is characterized by a high degree of flexibility. The grids of commercial office buildings are different, and the 6.00x6.00m grid is highlighted

as an example. Although there are examples with a floor height between 3 and 4 meters, a large number of buildings belonging to this typology, which are out of use, have low floor heights (some examples only 2.10m). This characteristic can be a major disadvantage in terms of conversion, given that the implementation of most other purposes requires a higher floor height, and changing the floor height represents a financially demanding intervention of a large scale. The depth of the tract, similar to the grid, is different and can be 4-8 m. The structure and arrangement of the internal walls of commercial office buildings can be characterized as cellular - the space is divided into a large number of smaller units connected by corridors, which can correspond to purposes with a similar organization of the internal space. Given that the internal space is divided, the area under the openings of these buildings in relation to the facade area is large. This feature can be a great advantage several other purposes and the organization of the internal space.

Figure 2 shows an analysis of the basic spatial characteristics of business facilities – conference and congress centers. As in the case of business office facilities, the skeleton system dominates. The grids of these facilities are different, but much larger than those of business office facilities, and an 18m grid is highlighted as an example. The floor height of conference and congress centers is large – an example is given with a floor height of 6.5m. A large floor height can be a great advantage in terms of repurposing a facility, as it is possible to implement a wider range of new uses.

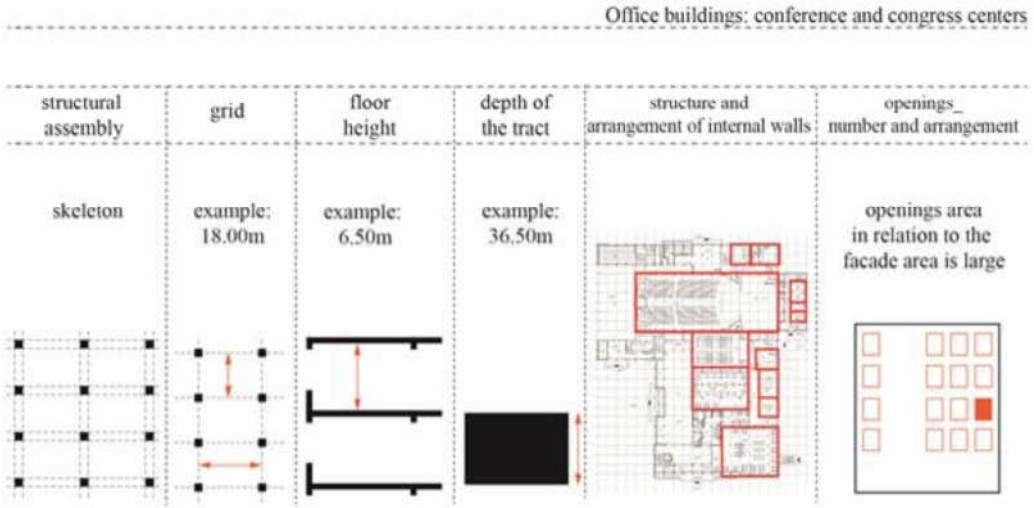

Figure 2. Analysis of the basic spatial characteristics of office buildings - conference and congress centers are significant for conversion, Authors

The depth of the tract varies, but is usually large, so the depth of 36.5m is given as an example. The interior space is divided into larger and smaller units, so the area under the openings is large in relation to the area of the entire facade, which is an advantage in terms of a greater number of options when choosing a new purpose. However, it is important to emphasize that office buildings of conference and congress centers are quite rarely out of use. Within the typology of office buildings, the degree of abandonment of commercial office buildings is much higher.

Figure 3 shows an analysis of the basic spatial characteristics of residential buildings.

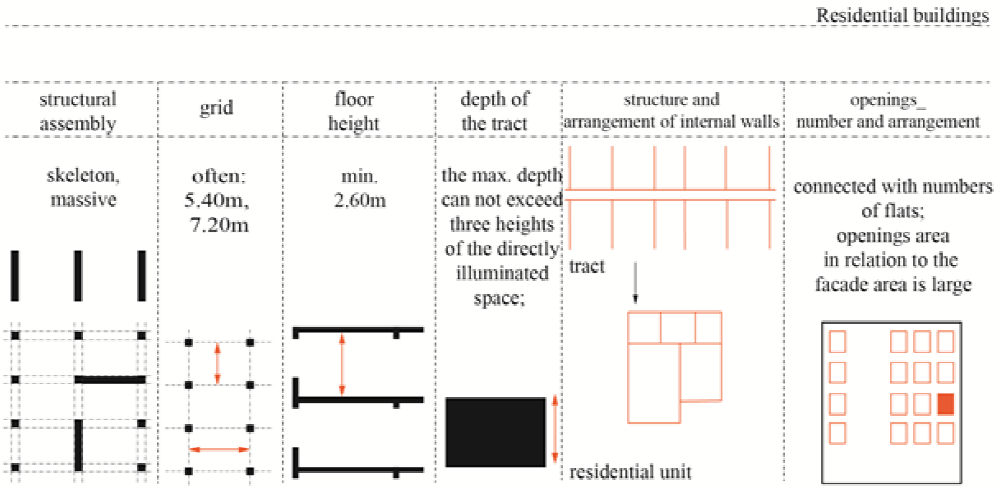

Figure 3. Analysis of the basic spatial characteristics of residential buildings is significant for conversion, Authors

Buildings of this typology are built in a skeleton or massive structural assembly, in grids of 5.40m or 7.20m, in most cases. The minimum, prescribed by the regulations, floor height is 2.60m. This prescribed condition is one of the very important factors when considering the implementation of residential use in an existing building. The maximum depth of the tract is also prescribed and cannot exceed three clear heights of the directly illuminated space. The interior space is divided by walls into units - apartments, and each of these units has its division. Given that buildings of several typologies have a similar structure of the interior space, from this aspect, residential use could be a new purpose for a large number of buildings. Buildings of this typology have a large number of openings with the facade area.

Figure 4 shows an analysis of the basic spatial characteristics of catering and tourist facilities. As representatives of this typology, hotel facilities were considered, given that their structure can contain both accommodation and catering parts (restaurants). The largest number of facilities of this typology was built in a skeleton system, in the grid that was also mentioned for residential facilities: 5.40m and 7.20m. Unlike residential facilities, the minimum floor height is not strictly defined, so there are cases among facilities with very low floor heights (2.30m). Although inadequate floor height has a negative impact on the quality of the interior space, the relative uncertainty regarding the floor height of facilities represents a certain advantage in terms of conversion, because hotel facilities provide a potential new purpose for a large number of unused facilities. Taking into account the high degree of diversity in the architectural approach to the design of these buildings, the depth of the tract varies, and 8m is highlighted as an example. The structure and arrangement of the internal walls differs in the accommodation and catering areas. The accommodation area is characterized by a cellular structure similar to office and residential buildings. The internal organization of the catering area involves separate units of different sizes, depending on the purpose of these rooms. The area under the openings is large in these buildings, in relation to the surface of the facade.

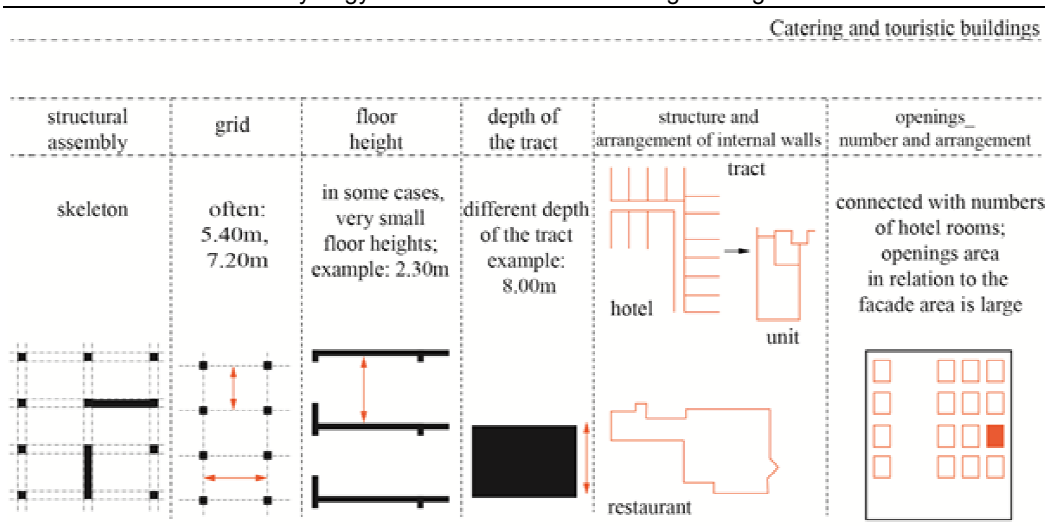

Figure 4. Analysis of the basic spatial characteristics of catering and touristic facilities significant for conversion, Authors

Figure 5 shows an analysis of the basic spatial characteristics of retail facilities – shopping malls.

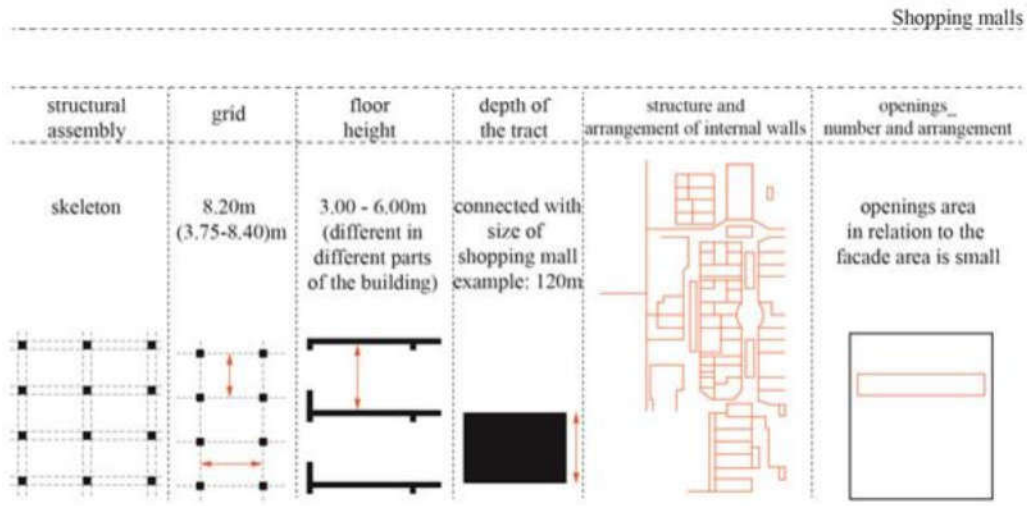

Figure 5. Analysis of the basic spatial characteristics of retail facilities - shopping malls significant for conversion, Authors

The skeleton structural system dominates, and the grids in which these buildings are most often built range from 3.75m to 8.40m. Shopping centers are characterized by a spatially very heterogeneous structure, so the floor height is different in parts of the building (3.00m - 6.00m). The depth of the tract is determined by the size of the shopping center, and an example is given whose depth of the tract is 120m. Taking into account the different activities that can take place in a shopping center, and therefore different spatial needs, the organization of the interior space of shopping centers implies an irregular division of space into units with a large difference in areas (unlike office buildings, for example). The area under the openings concerning the facade area is small, and the openings are most often arranged in a strip.

Figure 6 shows an analysis of the basic spatial characteristics of retail facilities – department stores.

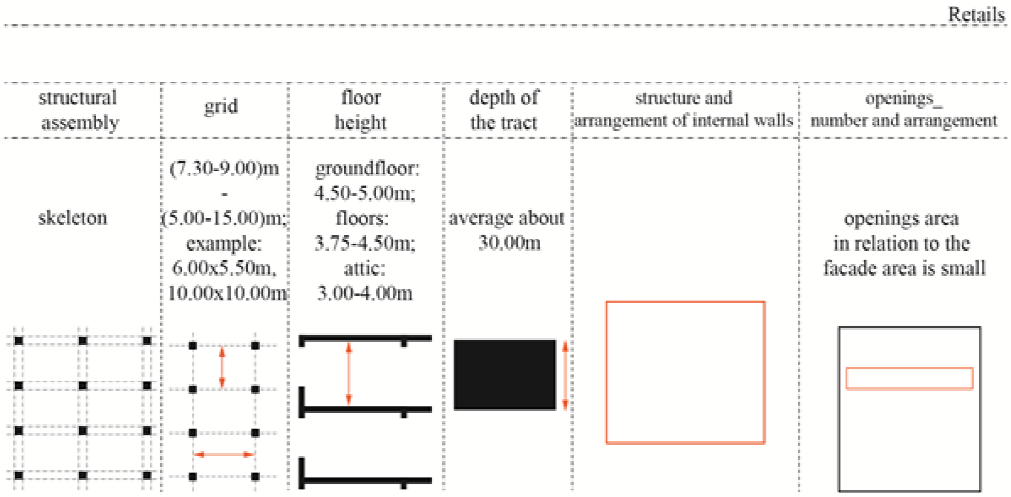

Figure 6. Analysis of the basic spatial characteristics of retail facilities – department stores are significant for conversion, Authors

The buildings of former department stores are, in large numbers, partially or completely out of use. When it comes to the structural system of department stores, the most common is the skeleton system, which was previously assessed as an advantage in the context of conversion. As an example, the grids 6.00x5.50m and 10.00x10.00m are given (the range of values for one dimension is 7.30-9.00m, and for the other 5.00-15.00m). The floor height of department store buildings varies by level: the floor height of the ground floor is most often 4.50-5.00m, the floors are 3.75-4.50m, and in the attic 3.00-4.00m. The average depth of the tract is about 30m. The interior of department stores is generally undivided, which opens up a range of possibilities for new uses without any structural interventions. The area under the openings is small in relation to the surface area of the facade.

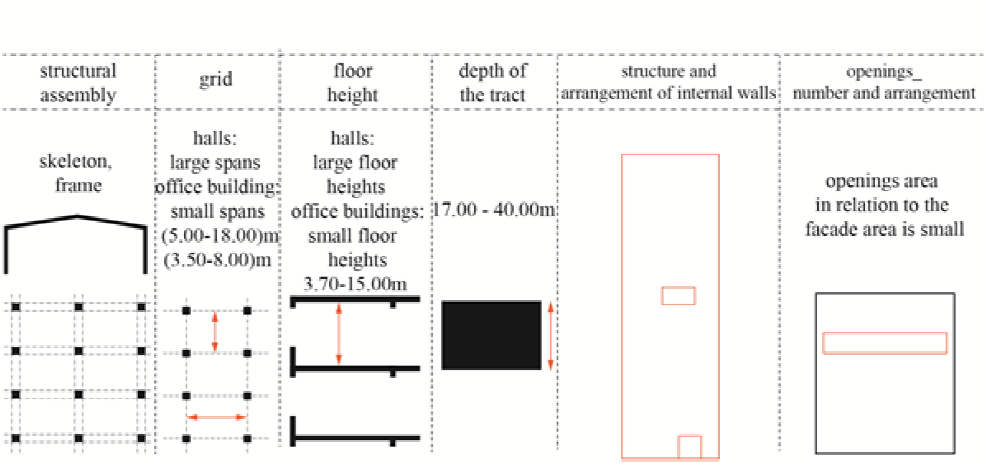

Figure 7. Analysis of the basic spatial characteristics of industrial facilities is significant for conversion, Authors

Figure 7 shows an analysis of the basic spatial characteristics of industrial buildings – industrial halls. Industrial halls are built in a skeleton and frame structure. The spans are large, and the grids range from 5.00m to 18.00m. The floor heights are not the same in all parts of the industrial building, so the range of floor heights is from 3.70m to 15.00m. The depth of the tract of buildings of this typology is large, from 17.00m to 40.00m. The interior space of industrial halls is a large, undivided space with separate cores (vertical communications), which provides many possibilities in terms of organizing the space for new uses. The area under the openings in relation to the facade area is small.

Figure 8 shows an analysis of the basic spatial characteristics of healthcare facilities. The largest number of facilities of this typology are built in a massive and/or skeleton structural assembly. The most common grid is 7.50m x 7.50m. The floor height is about 3.5m. The depth of the tract of healthcare facilities is greater, the circumference is between 14.00m and 18.00m. The interior space of these facilities is divided and consists of separate units of larger and smaller areas, depending on the purpose. As noted earlier in the pape, facilities with divided interior space, healthcare facilities are also characterized by a large area under openings in relation to the facade area.

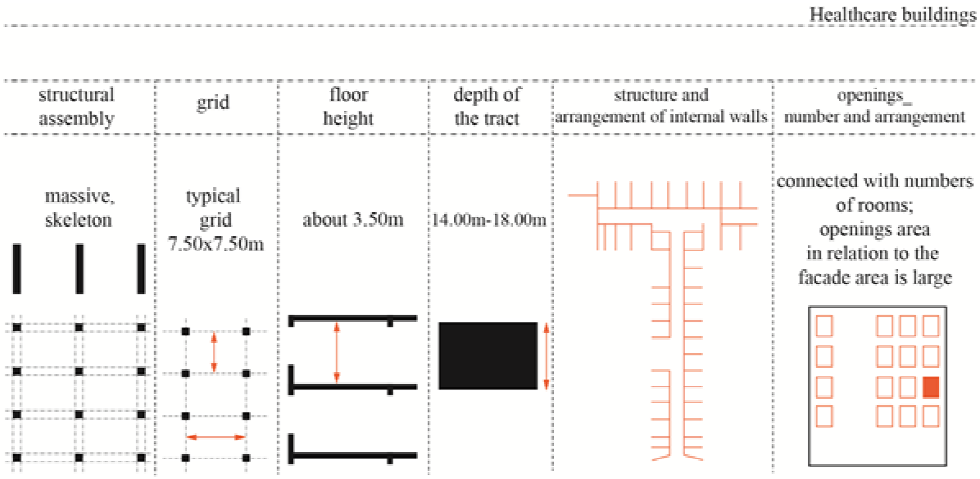

Figure 8. Analysis of basic spatial characteristics of healthcare facilities is significant for conversion, Authors

Figure 9 shows an analysis of the basic spatial characteristics of educational facilities (primary and secondary schools). The skeleton structure is dominant. The grid range is from 6.50m to 10.00m in one direction and from 6.50m to 7.50m in the other direction. Typical grids are distinguished: 7.50m x 7.50m and 6.50m x 8.50m. The minimum floor height is 3.00m, but varies in the range from 3.00m to 3.80m. The depth of the educational facility tract varies depending on the design solution (between 12.00m and 32.50m). The interior space is divided into units of different sizes, and the number of openings concerning the facade area is large.

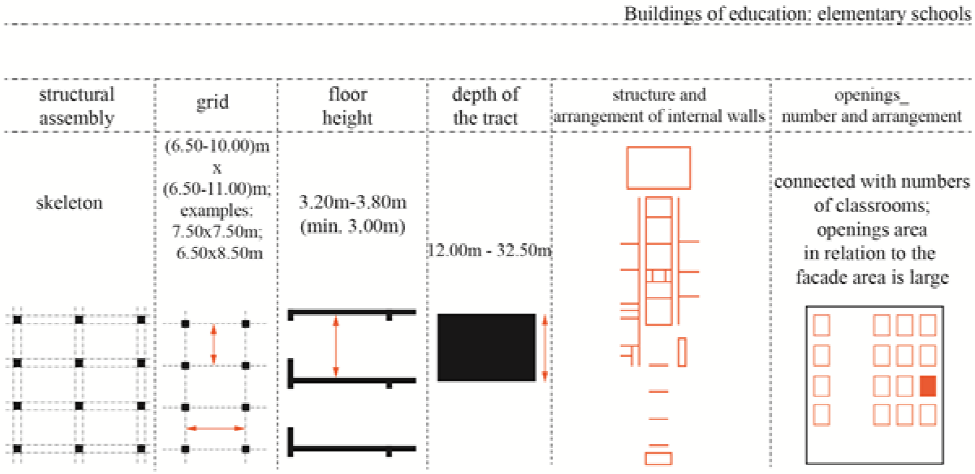

Figure 9. Analysis of the basic spatial characteristics of typical educational facilities (elementary schools) is significant for conversion, Authors

Figure 10 shows an analysis of the basic spatial characteristics of sports facilities. The structural assembly of sports facilities is skeleton or framed. These facilities are characterized by large spans that are determined by the type of sports activities for which they are intended. Although the minimum clear height is 2.50m, these facilities most often have large floor heights. The depth of the tract is different and is determined by the needs of the sports activities for which the facility is built. When it comes to the structure of the internal space, in most cases, larger undivided spaces (fields) and a series of smaller accompanying units next to them dominate. The area under the openings in relation to the surface of the facade of sports facilities is small.

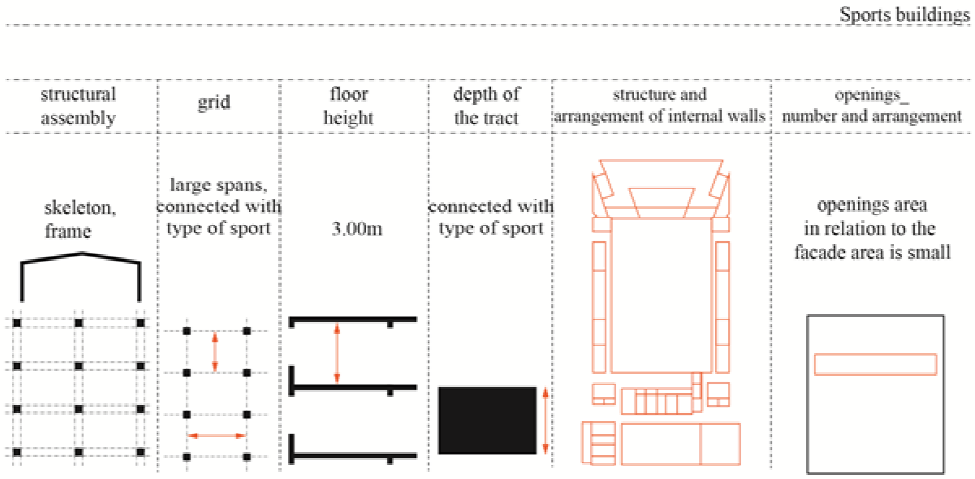

Figure 10. Analysis of the basic spatial characteristics of sports facilities is significant for conversion, Authors

3. CONCLUSION

The issue of potential new use is one of the most important factors in the entire conversion process. The presented analysis observed the basic spatial characteristics of typologies significant for conversion, the change of which during the potential conversion process would require more or less demanding structural interventions, which affect the duration and economic aspect of the conversion process as a whole. Compatible uses were considered to be those in which, during potential conversion, extensive and financially demanding structural interventions are not required. Given that the subject of the research is office buildings, uses compatible with these buildings were considered. The profile of a potential new use of a business office building based on the analyzed spatial characteristics (compatible uses) is as follows: **skeleton** or **frame structure**, **smaller spans**, **lower floor heights**, **smaller depth of the tract**, **cellular structure** of the interior space and **large opening area** in relation to the facade surface.

In this context, concerning the observed quantitative typological characteristics, it was established that office buildings can be most successfully adapted for the following purposes:

- **new office building** of a different structure (in line with modern ways of doing business that implies a greater degree of flexibility);
- **hotel** (taking into account the structure of office units, typical floors, and a larger number of floors), and
- **residential building** (in cases of adequate floor height and natural lighting).

The findings of this research make a significant contribution by laying the groundwork for developing mathematical tools to assess the potential for repurposing commercial buildings.

The conversion of unused commercial buildings into permanent or temporary residential buildings (tourist facilities, student and retirement homes) is a subject of research through theory and practice in a large number of cities. Several published publications describe the process of this type of transformation in the late twentieth and early twenty-first centuries in London, New York, Toronto, and Tokyo. In the case of London and Toronto, the conversion of commercial buildings into residential buildings was one of the ways to revitalize the central parts of these cities. In New York, in a part of Manhattan, and Tokyo, due to first the decline and then the dizzying economic development, new and better quality commercial buildings were built, so a large number of older commercial buildings remained unused. These buildings were transformed into smaller residential units as part of the strategy for the revitalization of this part of the city. In Amsterdam, the conversion of unused commercial buildings into permanent and temporary housing, predominantly social, was one of the solutions to the problem of insufficient available capacity of the existing housing stock. Numerous examples of good practice have been used to analyze various aspects of these conversions (economic, functional, environmental, etc.), which are most often determined by the characteristics of the buildings and their locations [15].

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