UNIVERSITY OF ZIELONA GÓRA

CIVIL AND ENVIRONMENTAL ENGINEERING REPORTS

E-ISSN 2450-8594

CEER 2025; 35 (3): 0150-0159
DOI: 10.59440/ceer/207286
Original Research Article

LOCATION OF FEATURE CATEGORIES IN THE SPATIAL CONTINUITY DIAGRAM METHOD

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A b s t r a c t

Looking after the spatial quality of urban complexes is a very serious challenge in the face of rapidly developing urbanisation processes. From the numerous discussions in the press and other communications, one can conclude that this is a socially important issue. The difficulty, however, is that many of the arguments in these disputes are usually based solely on emotional considerations. This article briefly discusses the method of the Spatial Continuity Diagram, which makes it possible to objectively assess the changes taking place in urban spaces in terms of the harmony of their extension or transformation. In addition, two research modules of the Spatial Continuity Diagram method are discussed: Compliance Calculator and a completely new research instrument called Feature Category Location.

Keywords: mathematical simulations, urban composition, spatial continuity diagram (SCD), compliance calculator, feature category location

1. INTRODUCTION

For centuries, urbanised spaces have been continuously transformed. This is a natural and in many cases desirable process. Transforming cities is a testimony to their vitality, economic, social and cultural prosperity. However, the processes of transforming or expanding existing urban structures are not always accompanied by an in-depth reflection on the preservation of the cultural and spatial continuity of existing buildings. Sometimes, inappropriate design decisions even result in the drastic deformation of whole sections of cities (Fig.1). One may ask what are the causes of these deformations. In each case, they may differ slightly. Nevertheless, in the author's opinion, the most common reason for deformations is the failure to take into account existing spatial and architectural contexts in the investment activities undertaken. In the examples concerning London and Toronto (Fig. 1A, C), the second plans were drastically changed, causing a decrease in the visual importance of such important historical objects as the Tower of London and the Old City Hall. The photos (Fig. 1B, D) show examples of deformations

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that occur on a smaller scale compared to the earlier examples. They consist in the failure to take into account the architectural values and height of existing buildings in new construction projects. Often, radical spatial transformations are explained, for example, by a desire to make the processes of adapting urban structures to new socio-economic challenges more dynamic. The ongoing discussions on the rightness or wrongness of these changes are very often based on emotive arguments without rational justification [1,2,3,4,9,10].

Fig. 1. Examples of disharmonious urban redevelopment. A - Grouping of skyscrapers in the background of the Tower of London, UK, B - Multi-family development in the immediate vicinity of the historic water tower in Koszalin, Poland. C - Grouping of skyscrapers in the background of Toronto Old City Hall, Toronto, Canada. D - New developments in the postmodern London Docklands, UK, 2020, W. Marzęcki

As a result, these debates are not subject to rational verification. However, we are not only dealing with a discussion of purely aesthetic issues, but above all of the urban-architectural impact of these changes on the daily lives of city dwellers.

In order to minimize the discretion or even randomness of design decisions, the Spatial Continuity Diagram (SCD) method was created. Recently, the SCD method has been enriched with two additional research modules: Compliance Calculator and Feature Category Location. The task of this method is to determine design guidelines based on objective data regarding the spatial and architectural typology of urban development subject to transformation. The aim of the SCD method is to support the processes of transforming existing urban structures by analysing their spatial and architectural features. As a result of the conducted research, design guidelines are created that support the transformation of existing urban structures in the spirit of maintaining their cultural continuity.

2. METHODS AND MATERIALS

2.1 Spatial Continuity Diagram

Based on the author's research and observations, it is possible to objectively assess the processes taking place in the sphere of transforming urban structures in the spirit of preserving their cultural values. For this purpose, an original method of verifying the processes of transforming or expanding urban spaces was developed, called the Spatial Continuity Diagram (SCD).

It is a method based on the use of also an original mathematical formula allowing the calculation of the degree of homogeneity of the studied features and their categories. This method was first described in the book Cultural Continuity in the Shaping of Urban Spaces, Characteristics and Method for Assessing the Quality and Variability of that Space, published in 2002 [5]. In a nutshell, it consists of identifying the spatial and architectural features of an existing urban development that is to be expanded or transformed in the future.

In the Spatial Continuity Diagram method, each feature is assigned a category of that feature. It is very important to note that there is no strictly fixed catalogue of urban and architectural features with their categories in the research process. Each time during the analysis of existing buildings, the set of features is determined individually, so that it reflects as fully as possible the character of the analysed urban space and architecture. Of course, there is a certain group of features that are common to most of the analysed urban complexes. However, many of the characteristics are present only in certain ensembles and do not appear at all in others. Thus when embarking on an analysis using the SCD method, it is first necessary to establish a catalogue of features and their categories which are most suited to the character of the urban space under study. It can be said that the correctness of the selection of features and their categories is of key importance in the analyses.

The primary task of the SCD method is to characterise the development to be transformed or expanded by establishing the degree of homogeneity of the characteristics selected therein and thus to create guidelines for future investment activities. Of course, any investment activity is preceded by the relevant projects. It is therefore crucial that these projects are also subjected to an identical SCD analysis in relation to the designed features of the new development. By comparing the results of the study of existing and planned developments, we can determine to what extent the new investment intentions will continue the character of the existing development and to what extent they will diverge from it (Fig.2).

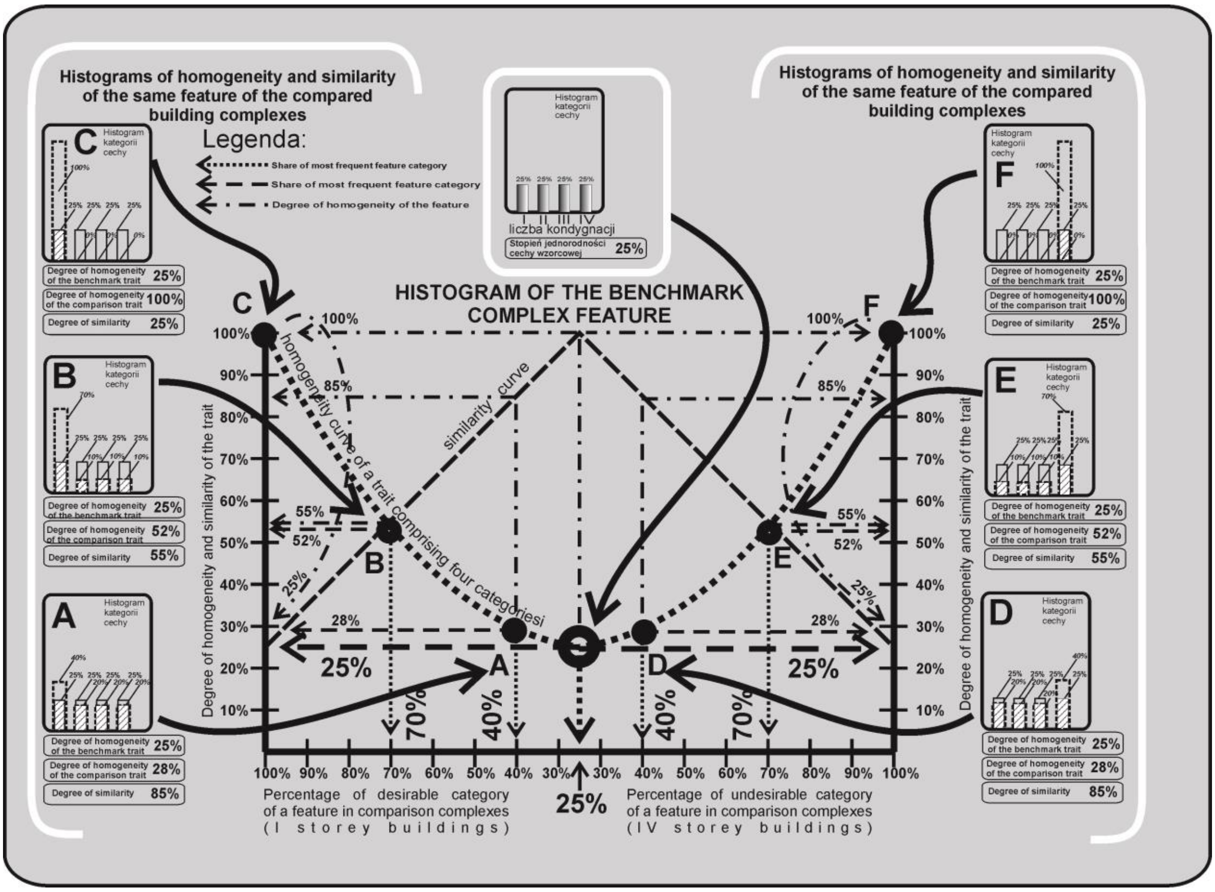

Fig. 2. Histogram of the similarity of homogeneity of the features of the complex of existing and newly designed buildings using the Spatial Continuity Diagram method, W. Marzęcki.

The large discrepancy between the two results may suggest a future deformation of the transformed urban structure. However, it should be very strongly emphasised that the SCD method is not intended to create a design copy of the development being transformed, but to provide an appropriate framework for the creative interpretation of the transformed development. However, by using the same features and their categories with a similar degree of homogeneity in the design, we will be dealing with a harmonious transformation or expansion of the existing urbanised structure.

The method has applied features. It was used to the fullest extent in the creation of the Wełtyń II local plan. The 50-hectare single-family housing estate is inspired by the single-family housing in the Pogodno villa district in Szczecin. The estate is currently under construction (Fig.3).[7].

In order to speed up the design work related to data analysis, a special computer program was created that automates all analytical processes and the formulation of design guidelines.

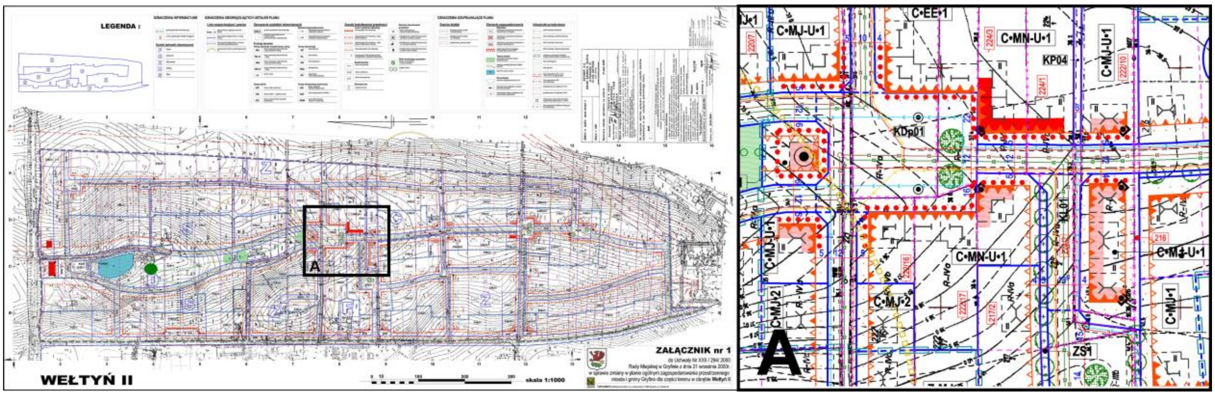

Fig. 3. Amendment to the general spatial development plan of the city and commune of Gryfino for a part of the area within Wełtyń II elaborated with the use of Spatial Continuity Diagram method, W. Marzęcki

2.2 Compliance calculator

The Spatial Continuity Diagram method is constantly being improved. In 2022, an additional research module called the ‘Compliance calculator’ was published in Architectus [8]. This module makes it possible to calculate the degree of homogeneity of a feature that is desirable from a spatial continuity point of view, depending on the percentage of new development in relation to existing development. In general, the greater the percentage of new buildings in relation to existing buildings, the closer their degree of homogeneity should be to each other. The homogeneity calculator allows the desired degree of homogeneity of the feature under study to be determined very precisely. This relationship is schematically illustrated in the three-dimensional simulation (Fig.4). The illustration shows increasing percentage expansion of a hypothetical urban complex (Fig. 4A, B, C, D, E, F). They are accompanied by graphs that allow for calculating the desired degrees of homogeneity of the features of complexes constituting expansions of the existing urban structure.

The Spatial Continuity Diagram method is continually being extended to new fields of research. The aim is to create an even more precise tool for objectivising the effects of planned transformations of urban structures. Particularly important is the increasingly precise delimitation of boundaries for investment processes, the crossing of which will result in a deformation of the architectural and spatial character of the buildings subject to transformation. Previous research modules analysed existing and planned complexes as comprehensive data sets. Their comparison provided an answer to the question of to what extent the data distributions of the existing and planned developments depicted by the respective diagrams overlap and to what extent they diverge, and in which areas. This allowed an overall assessment of the spatial effects of the planned transformations. The new research module described below is based on a slightly different analysis of the data obtained from the surveys of existing buildings and projects for their future transformation or expansion.

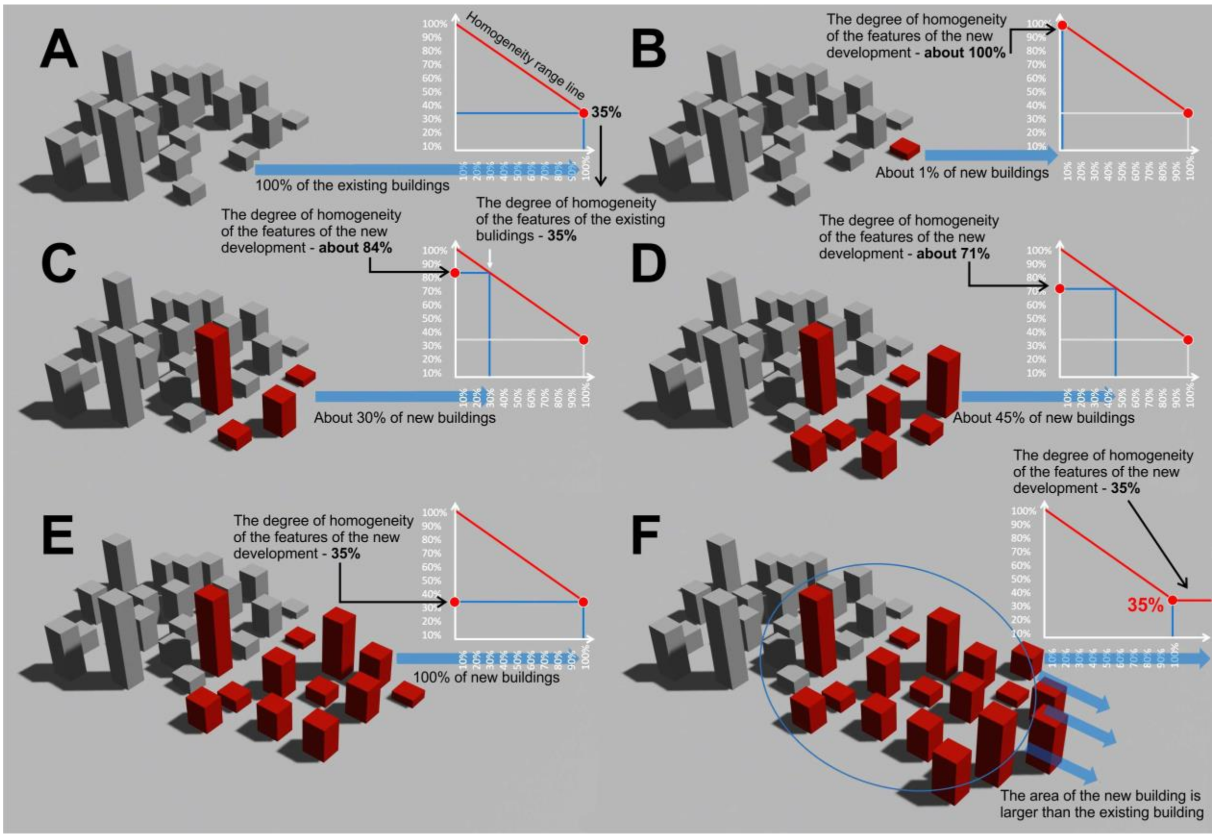

Fig. 4. Diagram illustrating the calculation of the desired degree of homogeneity of a feature in the process of extending an existing urban structure using the Compliance calculator research module. Grey blocks represent existing buildings. The red blocks symbolise new development that is an extension of existing development. W. Marzęcki

2.3 Feature Category Location

In the design practice using the Spatial Continuity Diagram method, it became apparent that a further aspect regarding the mutual locations of individual feature categories had to be analysed. For this reason, it was necessary to supplement the previous research with a new analysis.

This new research module, which is the subject of this article, is the ‘Feature Category Location’ analysis. The research problem to be solved by the ‘Feature Category Location’ analysis is illustrated by the following diagrams (Fig.5.) Let us theoretically assume that the examined development consists of twenty buildings. In the area of the feature category ‘number of storeys’, ten of them are two-storey buildings and the remaining ten are ten-storey buildings. According to the Spatial Continuity Diagram research method, the degree of homogeneity of the feature ‘number of storeys’ is 50%. In this theoretical model, let us assume that the ten-storey buildings are concentrated in the centre of the analysed urban area. The two-storey buildings, on the other hand, are located on the periphery of this complex. According to the adopted methodology, the new complex, which is to be a harmonious extension of the existing complex, should also be characterised by a degree of homogeneity of the ‘number of storeys’ feature, which is close to 50% in order to achieve the intended purpose. However, the desired degree of uniformity of the new development can be achieved in a number of design ways. Newly designed ten-storey buildings can, for example, be distributed on the periphery of the urban complex and two-storey buildings in the centre. If the quantitative proportions in both height groups are inventive then the result of the degree of homogeneity of the designed complex will also be identical and will also amount to 50% (Fig.5).

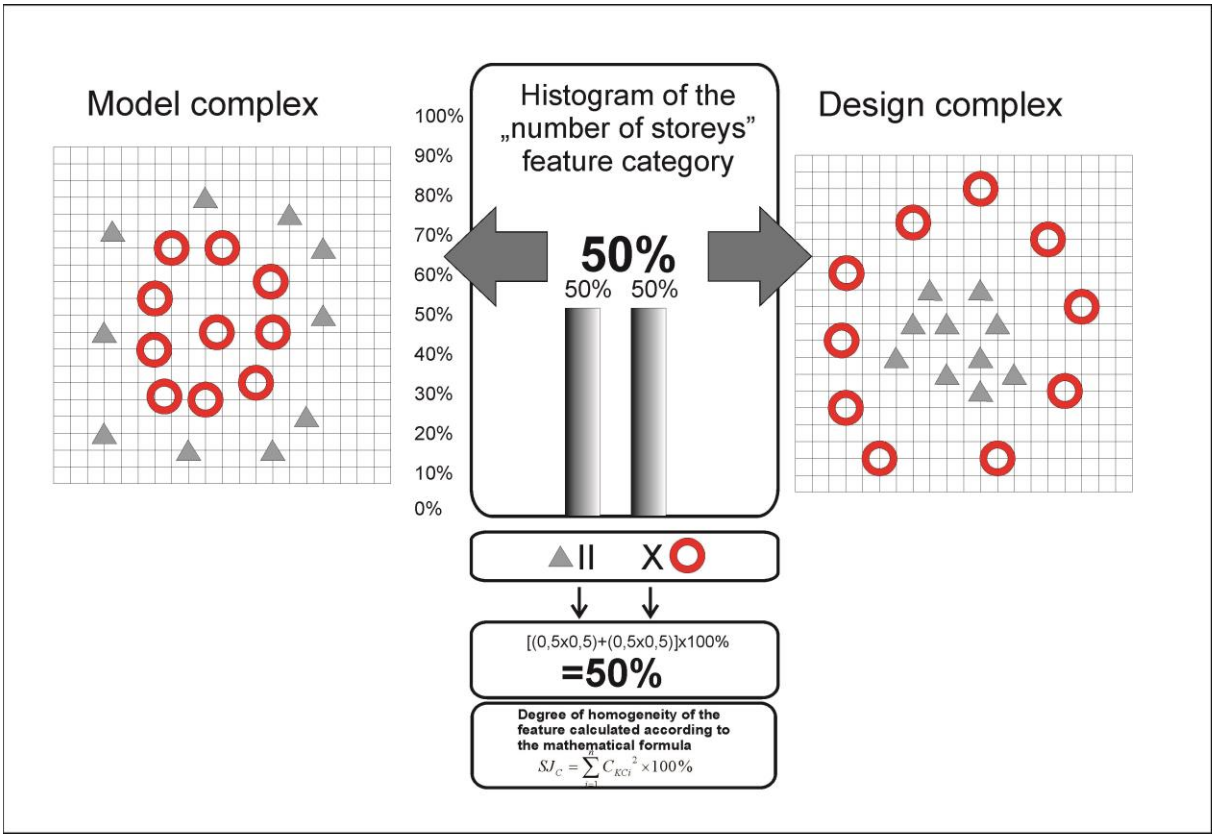

Fig. 5. Diagram illustrating the identical degree of homogeneity of feature categories with different spatial distribution of the same feature categories in two different urban models. Grey triangles symbolise two-storey buildings. Red circles symbolise ten-storey buildings. W. Marzęcki

However, the two complexes, existing and projected, will have an extremely different spatial character. This hypothetical example shows that in order to achieve a harmonious extension of an existing urban complex, in addition to similar degrees of homogeneity of the feature, it is also necessary to coincide the spatial distribution of objects of the same feature categories. Their location should, in principle, be close to the distribution of the model buildings. The quantitative data analysis of the percentage distribution and the resulting degree of homogeneity of the features in the Feature Category Location research module has been enhanced by comparative analysis. The spatial distribution of a feature category within existing development and newly designed development is to be compared.

It is very important to define not so much the detailed distribution within the study area of the individual feature categories, but to determine the general principle of distribution of the study feature category. To illustrate this problem, the example of the 'number of storeys' feature was used again, with the two categories of this feature cited earlier, i.e. two- and ten-storey buildings. By analysing the exemplary spatial distributions of the feature categories, we can determine whether a given feature category associated with individual buildings is, for example, concentrated in a particular area of the analysed development or rather dispersed fairly evenly throughout the invested area. There may, of course, be completely different spatial arrangements of the analysed feature categories.

The next diagram (Fig.6.) illustrates the different distributions of ten-storey buildings. The first spatial simulation illustrates the concentration of ten-storey buildings in the lower part of the analysed development with a frontage distribution of two-storey buildings (Fig.6A). The second spatial simulation illustrates the relatively even dispersion of tall buildings among the low-rise buildings (Fig.6B). The third spatial simulation shows a clearly striped arrangement of tall buildings against a similarly distributed two-storey development (Fig.6C). The grey arrows illustrate, in the individual diagrams, the general design idea behind the distribution of the analysed feature category in space.

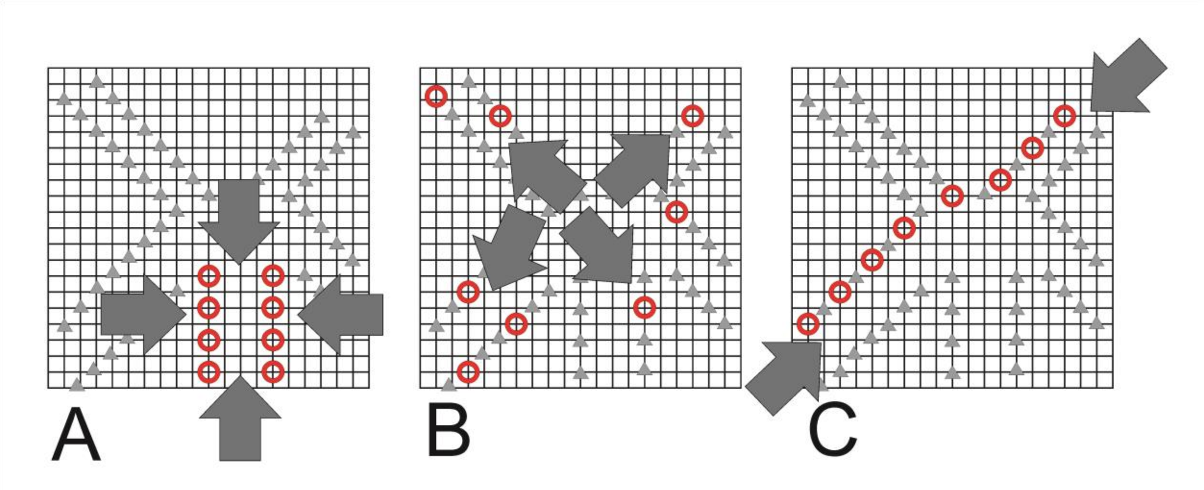

Fig. 6. Diagram illustrating how to interpret the distribution of individual features for benchmarking in the Feature Category Location research module. Grey triangles symbolise two-storey buildings. Red circles symbolise ten-storey buildings. W. Marzęcki

These three examples illustrate the fact that for the same 50 per cent homogeneity of a feature, we have extremely different spatial characters of the building forms analysed. In the design reality, there is a great variety and sometimes ambiguity in the location of individual objects. In the Feature Category Location research module, it is the definition of the general idea of the distribution of feature categories that is to be used as the basis for comparing the degree of harmoniousness of processes transforming urban space. Each new design project should take into account the above graphical analyses regarding the location of individual categories of the feature being examined.

The Spatial Continuity Diagram method was developed to study large urban areas. Consequently, many thousands of data are usually analysed. In order to facilitate the process of analysing such a large amount of data, computer software was created to support the study [6]. Their analysis makes it possible to capture the general character of development, sometimes difficult to define with a limited field of study. The premise of the DCP method is to make creative use of the character of model buildings in the design process and not to aim to copy it. Therefore, both the numerical data and the comparative analysis of the spatial distribution of the feature categories in the exemplary and designed development should be treated as a creative interpretation of this information. In this connection, the aim is not to make an exact spatial representation of the data obtained in the process of extending or transforming existing buildings, but to define the general character of the model buildings. This is the purpose of the Feature Category Location analysis discussed here.

To illustrate the interpretation of the analysed data, a rather extreme and undesirable example can be used, although it often occurs in urban structures. Let us assume that the model development does not have an unambiguously recognisable compositional pattern of the distribution of individual categories within the analysed feature. Let us also assume that this refers to an architectural feature this time involving roof slope coverage. The categories of this feature are, for example, felt, clay tile and sheet metal. In such a situation, the extension of such an urban ensemble should also include buildings with a variety of roof coverings and arranged in an unstructured manner. If one were to extend this ensemble with spatially ordered buildings whose roofs are covered with the same material, then such an extension would represent a spatial value contrary to the character of the original buildings.

As mentioned earlier, computer software dedicated to this method has been developed in order to efficiently carry out the analytical process on a large amount of data. It enables the efficient and automatic creation of guidelines for new buildings. Ultimately, however, it is the designer who, enriched with the relevant analytical knowledge, makes the appropriate design decisions with a view to fulfilling the spatial and cultural continuity of the expansion or transformation of existing urban structures.

3. RESULTS AND CONCLUSIONS

The result of the research described in this article was the improvement of the Spatial Continuity Diagram method by developing a new research module called Feature Category Location. The aim of this new research tool is to support the processes of expansion and transformation of existing urban structures even more precisely. The new research module is based on the analysis not so much of the quantitative share of individual categories of the studied feature, but of their spatial location within the studied urban structure.

Research to date on the issue of spatial and cultural continuity of transformed urban structures using the Spatial Continuity Diagram method leads to the following conclusions:

- The identical or similar degree of homogeneity of the studied feature in the model and designed buildings does not always lead to spatial continuity of the new development according to the assumptions of the Spatial Continuity Diagram method.
- It was necessary to develop a new research module called Feature Category Location.
- The comparative analysis used in the Feature Category Location research module significantly expands the catalogue of guidelines influencing design decisions aimed at harmonious transformation or expansion of existing urban complexes.
- The Spatial Continuity Diagram method, together with additional research modules: Compliance Calculator and Feature Category Location, is used in everyday design practice. Special computer software has been created that automates analytical work and the formulation of design guidelines.

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