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# City's Areas of Concern

## Space Syntax evaluation of urban design competition entries

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## ABSTRACT

This paper presents the author's survey card and illustrates the possibility of its practical use in evaluating the selected design solutions. Also, to check the implementation process of Space Syntax data coming from newly designed building complexes already at the stage of urban competition concept. The space syntax analysis covered a medium-sized European city (80,000 inhabitants). The problem areas are the void after the former sports stadium and the former market square in the city's center. City Council held the competitions for these neighborhoods, and individual entries were also included in the analysis. Data were collected for easy comparison in the form of a parameter sheet. The result of the research is a survey card for controlling Space Syntax parameters. A systematic source of knowledge verifying urban concepts in the spirit of accessibility addresses a broad audience: planners, developers, and local authorities' decision-makers. This approach allows the spatial positioning of the competition area to be captured in the broader context, bearing in mind the characteristics of individual spaces and the reciprocal dependencies between the many spaces that make up the entire city layout.

## KEYWORDS

Space Syntax, medium-sized city, urban concept competition, survey card

## 1. INTRODUCTION

Among the planning ideas and currents of research on urban planning theory, we can also find the city's understanding as a complex system subject to self-organization processes. The concept of Space Syntax, a relationship between grid structure – and potential flows identified mathematically, might be included. It also fits into the pragmatic trend of parametric and data-driven design.

The matrix development of Nowy Sącz (Poland) was the subject of the author's previous research precisely in terms of Space Syntax (Suchoń and Olesiak, 2021). Hence, it was easier to interpret and valorize the role of the indicated problem areas, also in the syntactic sense. It could also be shown that both problem areas are located along the historical central north-south axis of city development, which is at the same time a corridor of urbanity and urban activity from the Middle Ages to the present day.

## 2. THEORY

Contemporary urban planning theories are based on sustainability, public weal, and social justice. Three development policies correspond: balancing, integrating, and concentrating (Zuziak, 2015). The residents' quality of life includes access to culture, quality of the residential environment, educational facilities. The "social capital" consists of the participation in the public life of the inhabitants—mobility and transport concern local and global accessibility (Tota, 2017).

Space Syntax theory assumes that space is primarily a relational system. In other words, what happens in any personal space – whether a street, the interior of a city block, or a public open space – is fundamentally influenced by the relationship between that space and the network of spaces to which it is connected (Matějček and Přibyl, 2020).

Urban analysis based on Space Syntax theory makes it possible to demonstrate the structural differences between neighborhoods and determine the influence of the spatial advantages of different city areas. This opens up new possibilities to address the problem of segregation (exclusion) in urban design and more effective interventions in existing locations (Legeby, 2009).

Academic analyses of walkability in urban environments point to at least dozens of different elements or indicators that may be useful for walking behavior (Langdon, 2017). Among the most important are those that can be linked to Space Syntax theory and, at the same time, be accurately measured in the model: accessibility, the density of connections, Choice (attractiveness), and street layout structure. One of the significant areas in Nowy Sacz were selected.

1. Maślany Market, close to the center and services, itself a destination for many trips, now needs better Integration – inclusion.
2. „Stara Sandecja" sports field, due to its proximity to large residential settlements, mobility hub, education and science services, has the potential to become a new local center – currently lacking a functional program.

Figure 1: Graph of Integration values for the whole city of Nowy Sacz, Poland. Blue dots indicate both problem areas discussed in the text and their location against the background of the city structure. By author.

Over the past decade, urban planning competitions have been announced for these two areas. The competition proposals made it possible to implement a range of data variables and examine the analysis results in individual iterations after their input.

The requirements for a successful experiment are to isolate the structure from side influences and uncontrolled factors. The experimental research methodology introduces the practical aspect, the independent variable. Because urban research is inherently complex, the experiments on extensive urban problems are simulation-based. With the help of Space Syntax, the author examines the factors related to pedestrian accessibility and the inclusion of problem areas into the structure of the whole city.

Table 1. List of variables used in the model.

| Variable | Scale | Description | Measure |
|---|---|---|---|
| Max value of Normalised Angular Integration (NAIn, R=n) | Global / macro | Infinite radius, potential for mobility to | Numerical |
| Mean value of Normalised Angular Integration (NAIn, R=n) | Global / macro | Infinte radius (whole-city scale) potential for mobility to | Numerical |
| Max value of Normalised Angular Choice (NACh, R=n) | Global / macro | Pedestrian flow potential | Numerical |

| | | | |
|---|---|---|---|
| Mean value of Normalised Angular Choice (NACh, R=n) | Global / macro | Pedestrian flow potential | Numerical |
| Connectivity | Local / micro | Pedestrian flow potential | Numerical |
| Node count per sq km | Local / micro | Walkability potential | Numerical |

Another methodological challenge is to define the scope of analysis and delimitation of problem areas (Racu, 2016). The organizers of competitions limited the range to the abandoned site itself, leaving the surrounding streets as the buffer zone. As it is known, Space Syntax analyses are sensitive to the so-called edge effect; hence proper delimitation affects the later result. However, the author did not stop there and analyzed each solution in parallel at the scale of the whole city, with a radius of *n*. This provided a complete picture of the consequences of each design solution on the overall connectivity structure.

## 2.1. Stara Sandecja sports field

The so-called "Stara Sandecja" is an unbuilt green public space where the football stadium of the "Sandecja" sports club once was located. This peculiar city meadow lies abandoned after demolishing the outdated sports infrastructure but promises excellent development prospects. The subject of the survey was a preliminary assessment of the functional and spatial potential, indicating the possible role of the local center.

The authority did not define a program and requirements. Therefore, it was not easy to compare individual concepts, apart from perceiving the aesthetic appeal of the presentation. The common denominator and the possibility of mathematically precise assessment was the analysis of the values of Space Syntax and pedestrian accessibility indicators. For this purpose, successive axial maps were created, reflecting the network of connections resulting from individual design decisions.

## 2.2. Maślany Market square

The competition defined the task as the urban concept and revitalization program for the Old Town of Nowy Sacz. The issues were more or less linked to pedestrian accessibility. The proposed complex of profiled commercial services, artistic and regional handicrafts, and modern gastronomy aimed to serve the tourist traffic. The complex should be connected and associated with Maślany Market square by a pedestrian route, overcoming the protected relics of the medieval defensive system of the city. Still, the necessity and advisability of such a connection lead to a discussion on the choice of the solution. In AutoCAD, the author prepared schematic axes of all streets in Nowy Sącz and, in the Maślany Market area, additional axes of pedestrian routes on a local scale and building outlines.

Based on these diagrams, the Depthmap X program analyzed the Integration HH coefficients (the degree of Integration of a given space about the entire system) and Connectivity (the number of connections between a shared space and other spaces).

## 4. RESULTS

Although there are many applications of Space Syntax analysis, its main advantage is the proven correlation between the presence of people in a given space and the measure of its spatial Integration. This allows, among other things, to estimate with a high degree of approximation which places will generate user traffic in a given space. The more integrated an area is in a city, the more other spaces in the system will direct users to it. A high estimate of the Integration of a space element means that it is more accessible to users, and a low measure means that it is separated.

### 4.1. Stara Sandecja competition entries

Three competition entries were analyzed as representative and compared with the existing conditions. For this study marked as A, the first design variant consisted of closing the so far open space with service buildings volumes on the southern frontage. There were also introduced cutting paths for communication and paths for free walking, similar to garden composition. A pretty extensive network of pedestrian connections within the area was created (see Figure 2).

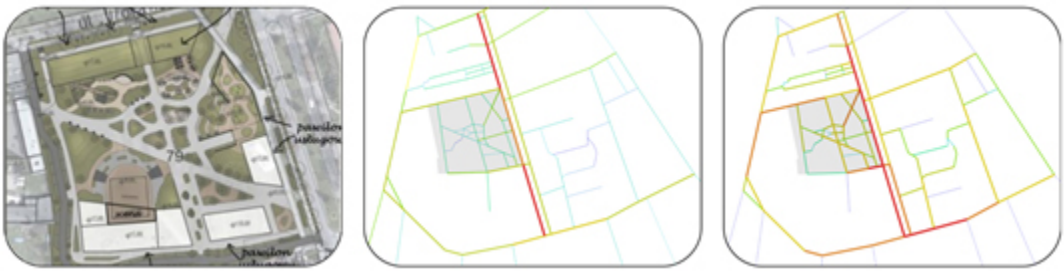

Figure 2: The competition entry, provisionally called Proposal A. From left, in sequence: the site design, the normalized Choice diagram, the normalized Integration diagram. The author compiled them.

Another design option, coded B for the study, was to create a so-called urban meadow. A sequence of smaller squares with dedicated recreational functions, cafés, or sports facilities would be built around a central open space. The last of the selected examples are marked with the letter C. This option left the space open while introducing a local community center. Two intersecting pedestrian routes axes were run through the area.

For all alternatives, including the existing condition, calculations were performed. The results and the values of the variables are presented in table below.

Table 2. Sandecja competition entries. Obtained values of variables in subsequent iterations.

| | NACh | NAIn |
|---|---|---|
| Maximum values | status quo: 1.484<br>proposal A: 1.483<br>proposal B: 1.474<br>proposal C: 1.492 | status quo: 1.552<br>proposal A: 1.622<br>proposal B: 1.649<br>proposal C: 1.612 |
| Mean values | status quo: 0.984<br>proposal A: 0.886<br>proposal B: 0.856<br>proposal C: 0.873 | status quo: 0.832<br>proposal A: 1.058<br>proposal B: 1.081<br>proposal C: 1.062 |

## 4.2. Maślany Market square competition entry

The analysis was performed at the scale of the entire city and the Maślany Market Square area. The results of the Integration HH analysis show a high degree of Integration of Lwowska Street concerning the whole layout, as well as the frontage of the Maślany Market and the Fire Station (see Figure 6). The Connectivity coefficient clearly shows no differentiation between the most connected spaces and the least integrated ones.

Isovist study was done for the urban interior of Maślany Market. Note the strong Integration and high value of Choice in the area of the Długosza/ Kościuszki/Sobieskiego intersection and the low value of Integration for the private interiors of the housing blocks.

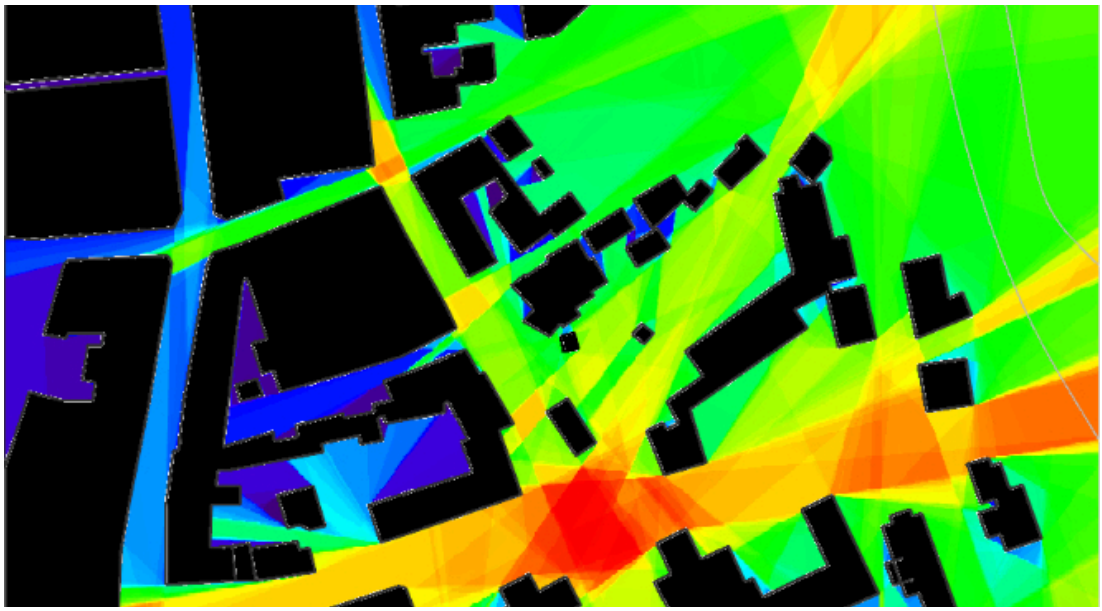

Figure 3: The Isovist study for the urban interior of Maślany Market Square. Integration HH coefficient values are shown. Compiled by the author.

The competition entry included the proposal of a small pedestrian link, crossing the barrier of the old, medieval wall and moat surrounding the strict center. This seemingly small movement did not affect pedestrian accessibility, as demonstrated in subsequent Integration and Connectivity analyses. Furthermore, the number of nodes and network connections per square kilometer increased.

## 5. CONCLUSIONS

The main advantage of Space Syntax analyses that the author wanted to demonstrate and use here is the ability to simulate the impact of design changes – even minor ones – for the entire system on a city-wide scale. However, there appears to be a more favorable evaluation situation when the control group is more extensive. This was the case with the "Sandecja" competition, as there were more than a dozen entries with quite diverse configurations. As a strand of parametric urban design, a more extensive array of data enables more iterations and thus more results to be compared.

This made it possible to collect a larger sample and tabulate the results. These Space Syntax indicators were taken into account, which impacts the assessment of "walkability." This summary can be a checklist for evaluating the competition entries. The measurable translation of the concept into pedestrian traffic flow (see Table 3 below).

Table 3. Sandecja competition entries. We are comparing the values of the variables and calculating the NACh score.

| | *status quo* | proposal A | proposal B | proposal C |
|---|---|---|---|---|
| NAIn mean | 0.832 | 1.058 | 1.081 | 1.062 |
| NACh score (NACh max / mean NACh) | 1.508 | 1.674 | 1.722 | 1.709 |
| Node count per sq km | 117 | 159 | 137 | 154 |
| Connectivity mean | 3.658 | 3.987 | 3.796 | 3.779 |

The tabular approach is complementary to other project evaluation tools. It provides an explicit association and opportunity to compare several concepts according to a consistent scale. Thus, a quantitative and qualitative assessment can be made. Space Syntax techniques can support the jury in their work and communicate results and indicators to a broader audience.

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