2TaLL

Exhibition of the research project 2TaLL
Application of 3D Virtual City Models in Urban Analyses of Tall Buildings

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Foreword: on the spatial analysis methods documented in the catalogue

Findings of the 2TaLL research project present a series of new analysis methods that facilitate studies on the impact of new buildings on a city. In particular, visibility studies based on Visual Protection Surfaces provide new opportunities for an urban planning practice that respects historical urban heritage. For example, the protection of urban skylines in historical cities can benefit much from the new possibilities offered by the analysis. Besides the visibility, the authors also examine qualities of public spaces and the shadowing effect produced by tall buildings in their surroundings. The megatrend of progressing urbanization and the growing need for built-up structures of high density will strongly influence urban development in Europe in the next decades. This emphasizes the necessity for modern digital planning tools as those developed in the 2TaLL project.

The integration of the third dimension in the visibility analysis of urban areas enables new and innovative systematical view analyses. The most important one is the comprehensive analysis of buildings visibility which combines the height of a building with its visual impact, namely the Visual Impact Size method. The innovative visualization method is capable of delivering a quantitative analysis in the form of an informative map which shows the visual impact of a building on its urban surrounding as well as its magnitude. A huge advantage is that the analysis is not restricted to selected standpoints but covers all possible points of view in an urban area. For this reason, the visibility analysis is considered comprehensive.

Case studies of such cities as Dresden, Brussels, Munich, Berlin, Frankfurt, Rotterdam, Delft and others provide very good examples of how advanced 3D-city models (including semantic information) can be used. In the years to come, such models will be created for a number of cities all around the world. The architectural research group has not only harnessed astonishing technical skills necessary to develop software for the computation of Visual Protection Surfaces, they also resolved challenges related to various input data types and formats such as Lidar data and CityGML.

The examples provided by the authors of the 2TaLL research project are visually appealing and illustrate the practical application of the method and consequently the huge potential of analysis methods developed. Hopefully, the research team can continue and further their work in this field.

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Tendency towards developing tall buildings in Europe

In the past two decades, tall buildings have become increasingly popular on the European continent. Not only did the number of tall buildings increase, but also their average height. This had a major impact on the historical landscape of many cities. Contrary to Asia or America, European cities developed through a gradual and rather slow evolution. Effects of the incremental development can be seen in the urban structure, typical spatial compositions and building silhouettes. Historical dominants have been well recognized and rooted in the public awareness as elements of the landscape, whereas contemporary tall buildings rapidly change that having its frequently random impact on important urban areas.

Examples of unfavourable changes to historical areas are many. Earlier, well known, examples include the axis of Champ-de-Mars in Paris ended with the Montparnasse tall building which disturbed this symmetrical and showpiece development in the city. While referring to developments in Poland we may give an example of the recently completed ING building at the Unia Lubelska Square that can be seen above the roof of the Belweder Palace from Łazienki Królewskie, Warsaw. Additionally, the view of the Tomb of the Unknown Soldier is interrupted by the Warsaw Trade Tower. It seems that no one has foreseen the impact of those buildings on the city, whereas such strategic views should be particularly protected. According to those examples, previous planning techniques do not provide an efficient protection. On the one hand, it is crucial to eliminated unfavourable visual interactions with historical buildings and, on the other, it is equally important to create an attractive city skyline with tall buildings as new spatial value and determining a proper location for such dominants in line with the urban arrangement of the city. Therefore, we need new techniques that in an objective and comprehensive manner help determining spatial consequences of tall buildings development in various locations.

Main project objectives

The tall buildings research under the 2TaLL project were two fold. On the one hand, the project research aimed at documenting selected examples of locations of tall buildings in European cities and analysing their impact on the landscape. On the other, the project focused on creating tools and computer-aided methods of simulating impact tall buildings have on space. New methods enable diagnosing the visual impact of a building in a city (VIS) and protecting important landscape clusters against the impact of new building (VPS). Additionally, the project developed analyses of public space (3D-Negative), shadow effect, Sky View Factor (SVF), and axial views (AXV). The new techniques are based on using digital 3D city models (CityGML, DSM/LiDAR).

One of the key objectives of the 2TaLL project was to examine and analyze the impact of tall buildings in selected European cities. Field studies took place in 13 cities of various size and spatial arrangement, including Amsterdam, Brussels, Dresden, Frankfurt, Koln, London, Milan, Munich, Nurnberg, Paris, Vienna, Warsaw and Wroclaw. The analysis aimed at documenting and assessing the impact of tall buildings on the landscape. The following factors were considered:

VIS analysis for a part of Berlin

Visual Impact Size (VIS) method enables identifying all locations in the city from which the planned tall building can be seen and showing its real visual impact range as well as assessing its strength. The analysis presents the scope and range of impact a planned tall building may have in the centre of the Victoria-Luise Square, Charlottenburg, Berlin. The study uses the CityGML model at LoD2. The area examined is 9 km².
New tall buildings in panoramas of European cities

Tall building developments is a subject of discussions, arguments and controversies which frequently reflect a dilemma between developing a new image of a city and restrictive protection of its historical landscape. Panorama of Milan – view from top of cathedral St. Maria Nascente di Milano towards north, with cluster of tall buildings in business district against mountainous background (2014-09) and (Below) panorama of London containing latest skyscrapers (incl. “20 Fenchurch Street”, “The Shard”) – view from Waterloo Bridge (2015-07)
Tall building absorption capacity

The impact of tall buildings on the city landscape depends on its spatial structure. The analysis presents sample simulations regarding visual impact range using the VIS method for different types of the urban structure in Berlin. Each area is 1 km² considered impact on the surrounding, impact on major axes and urban interiors and impact on a wider landscape (city skyline). Comparisons led to drawing general conclusions regarding specific nature of tall buildings described in other publications.

The study of selected European cities showed the scale and relevance of the issue of tall buildings, as well as an urgent need to find new analytical methods that can be used in spatial planning. Of course, the visual impact of planned investment is one of several factors to be considered (other include profitability, transportation, shadow effect, functionality, etc.). However, for external recipients of the finished architectural facility, the impact on the location and appearance from different angles are most tangible. In Germany, the development of mock-ups of controversial buildings (temporary constructions) is a common practice. The general public is then able to assess the scale of the planned investment. The 2TaLL Project attempts to meet those needs. While using digital tools, it is possible to foresee the spatial impact of planned facilities and their relations with historical parts of the city.

Analytical methods

The Visual Impact Size (VIS) method was developed for comprehensive assessment of the visual impact range of a given tall building. It enables determining which public locations in a city remain under the influence of a tall building. A single calculation process defines the range of the impact, namely whether we can see the building in whole or a major or minor part of it. The method enables measuring the visual impact of a building at various heights. The results are generated automatically in the form of a 2D map. The interpretations of findings may be crucial for determining further directions of future planning. The VIS map becomes the foundation of the study as well as a basic tool for assessing the impact on the city landscape. It also helps identifying important exposition points of a building in the historical context of Warsaw.

Yet another example is the Visual Protection Surface (VPS) method which focuses on protecting the background of important city skylines. The method enables determining height limits for certain buildings. Input data comprises coordinates of exposition points for strategic views that need to be protected (which is in line with policy of spatial landscape protection and development in many cities, e.g. London). The computation process generates a surface above the city determining the maximum height of buildings, buildings which are not seen from protected viewpoints. VPS can be used to analyze the capacity of a city to absorb tall buildings. The method can also verify consequences of spatial strategies and changing the height of buildings in a city. VPS was used for the first time in studies on Dresden, a city of landscape values that are unique in Europe.

VIS and VPS are complementary methods as regards examining of urban landscape as well as planning applications. VIS has broader origin and is deeply rooted in previous research, whereas VPS has been studied in theory, however not yet developed in practice. Finally, the 2TaLL project research and the development of new programming tools enabled possibility of applying both methods to the same facilities [in vector model environment and city models based on cloud of points]. Although, both methods are used for
Axial views study on street grid in Warsaw

An important tall building perception factor, critical for interpreting the findings of the VIS analysis, is the urban composition of a city. The composition of a city is determined by the street grid which can be subjected to an objective analysis. The simulation of a 25km² section of Warsaw, presents the impact of a tall building along street axes analysing the city landscape, but the analysis focuses on two different issues: the impact of a building on the landscape, and protection of a view and its implications for developing buildings in a city. When applied together, both methods enable versatile and multifaceted analysis of the landscape and assessment of its absorption capacity as regards new investment, including tall buildings. The application of the methods in spatial planning can significantly improve the quality and reliability of decision making as regards their impact on the development of a city.

Tall buildings has a major impact not only on the landscape but also on the quality and functioning of public space in a city. The above was a subject of a separate research under the project. To a large extent, the urban structure is the effect of a game involving the positive and the negative, in other words buildings and space. The game also involves inhabitants of a city. The Positive is the form of buildings, structures, facilities or elements of the natural landscape. The Negative is the world of invisible geometry determined by the structure of the Positive. The form and geometry of buildings can be seen directly, whereas the geometry of space between buildings is not measurable directly. This led to the development of the 3D-Negative method which enables (based on CityGML model) generating a 3D public space model, or the negative of a city, and then analyzing its geometrical parameters: the spectrum analysis (CSP), angle typology analysis (TBS), dimension typology analysis (TDL), study of public space planes and surfaces (TBL, TBA). Research on public space also focused on the intensity of the shadow effect produced and obstructing the view by tall buildings. The study applied specialist software providing for calculation of sun exposure time and Sky View Factor (SVF), a tool that enables calculation of surface area obstructed.

Possibilities and limitations for using 3D city models

The analysis of city landscape and the study of tall buildings impact are based on 3D city models. Accessing these resources was necessary to meet objectives of the 2TaLL project. A major issues was also adjusting the methods to current standards used while recording city models. A factor which helped implementing the project was the implementation of the EU INSPIRE Directive which required member states to facilitate and improve access to spatial information. The advancement in terms of quality and accessibility of data was such that changes could be seen during the implementation of the project. Acquiring certain resources, however, required separate agreements (e.g. model of Berlin), which is today ‘open source’.

In the first stage of the project, research used solely 3D city models in the CityGML standard. The term ‘standard’ is crucial: CityGML makes 3D data independent from the environment of the model, which is a major difference if compared to CAD models, in which data are linked with a specific program and their transfer to other programs usually involves certain loss. It is regrettable that still 3D city models are requested to be developed in CAD, e.g. a new 3D model of Warsaw. CityGML models are standard in Western Europe, in particular in Germany. They enable recording not only the geometry of buildings but also data semantics (description of mutual relations between elements of model). Thus, the format covers various classes of objects (e.g. buildings, water, tunnels, and bridges) and enables recording them in various precision scales (LoD). In practice, incompleteness of a model is a frequent drawback, which means that it does not reflect all elements of the actual city space. For the purpose of research under the 2TaLL project, CityGML models were acquired covering whole or parts of 8 Euro-
Dresden is a unique example of a city where the entire exposition of historical buildings has been preserved (or restored after war) unchanged for several centuries. Today, it is a crucial part of the city’s cultural heritage. The panoramas can be observed from a several kilometre stretch of boulevards on the Elbe River. Below: a 3D visualisation of the VPS, encompassing the protection of the background of Dresden panorama seen from the southern 2 km boulevard of Elbe, between bridges of Marienbrücke and Albertbrücke. The surface determines the permitted building height.

Different digital recording of space is used in city models based directly on Airborne Laser Scanning (LAS, DSM, DTM models). Aerial scanning data are a semi-processed product for developing vector models. However, unprocessed picture of a city in the form of a cloud of points can be a basis for using landscape analyses. Some major factors include cost, validity and access to data. In the case of Polish cities, CityGML models are virtually not available. However, the nation-wide flood protection programme ISOK produced LAS, DSM and DTM high resolution models for all major Polish cities (much better than in German cities). The 0.5m DSM model enables reflecting basic architectural relations. A major advantage of the city picture produced is a complete presentation of all spatial elements with the same precision. In the second stage of the project, some of the methods, including VIS and VPS, were adjusted to process DSM models, which required other (recurring) algorithms and software solutions. Research using DSM models covered 4 Polish cities: Warsaw, Szczecin, Lublin and Wrocław.

Exchange and dissemination of knowledge and prospects for further research

The 2TaLL project required an interdisciplinary approach, including integration of various scientific fields and reaching a number of research communities. A major achievement, important from the point of view of dissemination of findings and broadening knowledge of the researchers, was the participation and presentations delivered during three leading international conferences of various scientific profiles, such as geometry (ICCG16: International Conference on Geometry and Graphics, Innsbruck 2014), environment remote sensing (ISRSE36: International Symposium on Remote Sensing of Environment, Berlin 2015) and digital urban analysis (SSS10: Space Syntax Symposium, London 2015). Each of the conferences had its impact on the direction of research under the project. Contacts made resulted in further exchange of knowledge and presentations, e.g. in Croydon (City Planning Department, July 2015), London (Urban Design London, September 2015), Weimar (University of Bauhaus, January 2016) and Dresden (Planning Department, February 2016). During the project, in total 31 activities took place promoting exchange of knowledge in 20 European cities, including studies, conferences, presentations, exhibitions, etc.

For its successful implementation, the project required specialist training and consultations aimed at broadening knowledge and competences of project team members. A milestone development included a training on the CityGML standard and FME software organized by Virtual City System in Berlin (July 2014). The training helped developing skills of using CityGML models and enabled creating programs by project team members to process such data (crucial for e.g. 3D Negative). Other training and consultations were held in Poland and focused on GIS techniques, programing and mathematics. The transfer of knowledge enabled developing the capacity of the team, new analytical methods and computer applications (C++). The process helped verifying suitability of city landscape analysis systems (e.g. ESRI).

The 2TaLL project aimed at supporting the process of harmonious landscape development in a city in the context of assessing locations and spatial parameters of tall buildings. Methods developed,
such as VIS, VPS, and 3D-Negative, create a basis for various urban analyses in the field concerned. The scope of the research covered the visual impact and exception which, in the opinion of the authors, is the most crucial factor for the development of a city. The methods were applied to various cities in Europe based on their 3D models. The purpose was to show visual interaction promoting objective geometrical examination. The precision of results achieved can be debatable, whereas the method itself is not. Of course, even the most precise simulation can merely support decision making in urban planning. However, considering the complexity of the issue, such a support can be invaluable.

In the future, the 2TaLL team intends to promote project findings and develop software created to be further used in research and spatial planning. The team would also like to include landscape analysis and the use of various cities’ models in education.

Footnotes:
6 ISOK – a project of system that improves the cover of the economy, environment and society against extraordinary threats, especially against flooding.
3D-Negative model of Lörrach in Germany

The form and geometry of buildings can be seen directly, whereas the geometry of space between buildings is not measurable directly. The simulation presents a 3D model of public spaces system in Lörrach generated from CityGML model by using 3D-Negative method.

2TaLL — scientific background, achieved results and further prospects

Waldemar Marzęcki, prof. dr hab. inż. arch.

Recently, we have witnessed a tremendous increase in the number of tall buildings erected in major urban agglomerations of the world. The same phenomenon has been observed in many European cities as well. While comparing the historical process of urban structure transformation and current changes in the urban space, the latest development seems to be particularly significant. Transformation of the urban space involves rather qualitative than quantitative changes. During their growth period, the majority of cities underwent far-reaching transformation or expansion. However, the impact of the then changes on the perception of urban space was smaller than it is today. When new facilities were built, they had rather limited impact on the urban landscape, since new buildings were more or less similar regarding their scale, proportion and architectural form to those already existing. In the case of tall buildings, the spatial situation of the city structure changes dramatically. A single tall building may have a major impact on the arrangement of the entire city.

Traditional urban analysis methods seem sufficient while examining the potential impact of new buildings that have similar height to those situated in their vicinity or facilities that play the role of sub-dominants. The situation changes when we examine the impact of tall buildings on the existing urban development. Such buildings make a versatile impact on the spatial composition of a city. They can be seen at far ends of streets or stand out in the interior urban development, be exposed at the foreground, and in particular instances influence the skyline of a city. Therefore, protection or possibly evolution of the historical city space should be carefully considered.

While analysing the impact of tall buildings on the spatial structure of a city, it is necessary to develop new research methods that support the investment decision making process and facilitate multifaceted analyses. It seems obvious that particularly complex spatial relations between tall buildings and their surroundings as well as existing buildings should be considered in the context of the entire city. Thus, without a support of digital techniques, the implementation of a reliable study is virtually impossible. Results of this study extend beyond our imagination and even the best intuition of an urban planner is insufficient.

On the one hand, the authors of the exhibition, doctors Klara Czyńska, Paweł Rubnowicz and Adam Zwoźniński, use latest digital analytical tools in their research, tools which simulate the earth surface and facilities located there, while on the other the three researchers develop new scientific theories and expand the variety of digital urban analysis methods by adding their own, such as VIS (Visual Impact Size), VPS (Visual Protection Surface), and public space 3D-Negative. It is worth emphasising that the new methods are genuine and based on advanced software originally developed by the authors virtually from scratch. Their research topic is interdisciplinary and requires a combination of professional knowledge and skills in urban planning and digital city imaging, GIS, geoinformatics.
Analyses of public spaces by 3D-Negative

Tall buildings have a major impact not only on the landscape but also on the quality and functioning of public space in a city. 3D-Negative methods enable mapping of geometric features of public spaces in 3D virtual city models using primitive geometric components. Top left: Typology by Length (TBL) – Delft/NL; top right: City Spectral Profile (CSP) – Lörrach/D; below: Typology by Area (TBA), Rotterdam/NL.

The position of the research team strengthened in 2014 with a grant from the Norwegian Financial Mechanism for implementation of the 2TaLL project on the Application of 3D virtual city models in urban analyses of tall buildings, a project headed by dr inż. arch. Klara Czyńska. In the group of 200 project applications competing for grants, the 2TaLL project received the largest number of points. The high project assessment confirmed significance of the research topic for the contemporary science.

The exhibition crowns the novel research on the urban space as well as tremendous dedication of the research team to solving real project issues. Since 2005, the research has been based on close relationships between architectural science and practice. The best example of its practical applicability are studies on the urban space of such Polish cities as Szczecin, Lublin and Warsaw. Scientific achievements and project findings provide a major contribution to developing innovative methods used for analyzing urban structures.

The 2TaLL Project, implemented in 2014-2016 by a team headed by Klara Czyńska and involving doctors Paweł Rubinowicz and Adam Zwoliński, was crucial for the scientific development of the team. In particular, this applied to the project leader (Czyńska), but also individual team experts responsible for specific interactions in the project (Rubinowicz, Zwoliński).

The attainments presented in the exhibition are a major contribution to innovative urban structure analysis methods so much valid and important for the contemporary development of cities in Europe. The research implemented and methods developed enable: a) better forecasting of spatial consequences of certain planning decisions as regards the development of tall buildings, b) defining their significance for the public structure in a city and c) examining the capacity of a city as regards tall buildings, while taking into consideration its historical landscape. Findings of the 2TaLL project have a European dimension. This has been proved by the scope of activities under the project implemented in various cities in Europe. Considering project statistics (list of trips), activities such as in-situ landscape studies, scientific conferences, training courses, lectures, presentations, and exhibitions on the 2TaLL project took place in as much as 20 European cities (in alphabetical order: Amsterdam, Berlin, Bialystok, Brussels, Dresden, Frankfurt, Gdansk, Innsbruck, Köln, London, Milan, Munich, Nürnberg, Paris, Szczecin, Świnoujście, Warsaw, Weimar, Vienna, and Wrocław).

The strong position of the team has been confirmed by their participation in major conferences of diverse scientific profiles (ISSG16, SSS10, and ISRS16), and numerous contacts with research centres (e.g. Bauhaus University of Weimar), planning centres (Croydon and Dresden) and the commercial sector (e.g. VCS Berlin). Landscape in-situ studies were implemented in several European cities, whereas 3D modelling focused on such cities as Berlin, Delft, Dresden, Frankfurt, Lörrach, Rotterdam and Warsaw. Methods developed by the research team are universal and can be applied in various virtual city models (from simple LiDAR/DSM ‘point clouds’ to semantic CityGML models).

Findings of the research presented by the exhibition put the authors in the group of people who promote experimental science at the global scale. I should congratulate the team and cross my fingers for their future success!

Waldemar Marzęcki
prof. dr hab. inż. arch.
Mierzyn, 2016-02-09
Public space and tall buildings – shading & screening

Tall buildings direct impact assessment by analysis of shadow cast to public spaces around. The impact was measured and simulated by using SunHours tools for calculation amount of sunlight received by public spaces during daytime.

Below: Analysis of screening effect by tall buildings using Sky View Factor tools in virtual city model of Frankfurt

Review & contribution to discussion on 2TaLL project

Robert Barełkowski, dr hab. inż. arch., prof. ZUT, UTP

In his essay on the beauty in science, and more specifically in rules discovered by the science that are applicable to the perceived material reality, Subrahmanyan Chandrasekhar states that frequently research leads a man to a conclusion that the truth can be expressed in both simplicity and beauty. The elegance of simple, however not primitive, solutions, and the complexity expressed using a transparent code reflect principles of mathematics, physics, genetics and several other disciplines.

For a number of years, a team, comprising dr inż. arch. Klara Czyńska, dr inż. arch. Paweł Rubinowicz and dr inż. arch. Adam Zwoliński, has been developing a concept of spatial analysis of an urban structure using digital techniques. In their research, members of the team found a simple formula and range of applications for the method, which are expressed in a modelling (simulation) analysis involving algorithms using highly advanced data and the reconstruction of the spatial environment concerned. Although the principle is simple, it does not translate into a simple application. The path from an idea to its efficient application is far from being uncomplicated, like impressions one may get from examining analytical models presented in the 2TaLL project exhibition.

The output of those three researchers evokes respect. Not only did they succeed in formulating a simple idea and showed the entire process of developing the analytical tool, which presents visual impact areas in a city involving shadowing and revealing of specific objects, but more importantly provided for a very useful application of the tool which does not happen too often. While referring to the project concerned, allow me to digress in passing on the absurd ways of distributing grants and qualifying project proposals which in the opinion of assessing parties should not have a practical application, for certain not a commercial one. This, however, completely neglects a specific nature of the discipline of architecture, where the application by architects and urban planners cannot and should not compete with the application by civil engineers in such areas as those covered by the 2TaLL project. In fact, the research should be supported and promoted if findings of the research are going to be commercialized later on. In the discipline concerned, it is the only way of achieving a breakthrough while integrating academic and professional spheres, so much emphasized by those who attempt to improve the effects of research findings.

The 3D simulation of a city, representing its real environment, with its potentially crucial locations that accumulate urban processes, is an example of a scientific achievement that can be practically used in designing. I believe that the issue of spatial analysis should be considered in a broader context.

Czyńska, Rubinowicz and Zwoliński have built an analytical tool as the first very important step that highlights aspects of the urban space which escapes human senses and imagination before it is too late. This is an instrument for anticipating effects of operations in that space, which are far reaching and durable, operations of irreversible effects once they are implemented. Although the tool has a narrow application, it plays its role wisely and in a comprehensive and complete manner. The result of the research is capable of producing immediate results and has high value and utility by determining a very specific impact on the urban space. It can be a component of an urban space management system, and much more.

As mentioned earlier, it is the first step indeed, since a city is a sort of a biotic structure that depends on life cycles and specific metabolism, and the analogy to an IT being can be solely seen as an elementary simplification of very specific and controlled principles. As expressed by Michael Weinstock and Mehran Gharleghi in their essay on Intelligent Cities and the Taxonomy of Cognitive Scales, the...
development of IT techniques is sufficient so, from a conceptual point of view, people and the civilization should start considering a reasonable integration of collective social awareness. In this awareness and inter-subjective experience, the urban space is a key habitat with its digital dimension such as the system city management. And it includes vibrating and fluctuating electronic interaction between users and urban facilities, an integration which at least partly has its own identity. The authors rightly indicate that cities were created in result of interaction between the collective intelligence of inhabitants, who managed to combine a specific nature of a place, its hard infrastructure and administrative mechanisms invented by that society to control efficiently the direction for the city evolution. Considering the above, the work by the three researchers virtually does not touch upon the issues raised by Weinstock and Gharleghi. It seems that it rather focuses on the analysis of the form or possibly the structure. Such approach to the issue concerned as comprehensively covered by the 2TaLL application would be too superficial. Suffice it to say, the direction for the development of research on the architectural space, and even more so the urban space, as expressed in Space Syntax conceived by Bill Hillier or certain architectural applications by Herman Hertzberger, which referred to a limited perspective of the phenomena of space (and I do not mean by any chance phenomenological perspective!). In fact, it boils down to the relationship between a man and his self, awareness of experiencing and feeling, for which the empirical sphere translated into emotional co-development of living conditions is particularly important. The comfort of sensing the space, including public and generally accessible one, and its quality and harmonious, however not necessarily unified, development have direct impact on human wellness. Christian Derix referred to such issues when formulating a postulate of a bottom-up development of space. The process involves relations between a kinetic perception, awareness of space and phenomenological generation and perception of spatial phenomena and physical objects independent from a man and those which he created. It can be described as an anthropocentric process in which not only functional but also formal requirements (not mentioning aesthetic requirements) constitute a premise for developing architectural or urban solutions, and the environment and its user gain direct and indirect ways of influencing the shape of the habitat regardless whether they are architectural clients. Whether it happens consciously through participation or analytically through reflecting on human behaviour determined by the local cultural imprint is not important at this level of general description.

Psychology of space plays a tremendous role both for the urban as well as architectural dimension. The evolution of city structures is more complex than that of individual architectural facilities. An learned architect, in his/her capability of absorbing knowledge from the user of space, needs to remember about the triple nature of space representation, a space which he/she is would like to transform: explicit and implicit expectations of users and objective needs we are unaware of. The contradictory nature of the three modes in which space can be perceived, strictly correlated with each other, requires us to at least partially atomize the issue of urban space quality in order to develop efficiently the empathic picture of a city using suitable elements. The authors have developed one of such components – an individual calculus of a complex picture, a calculus which is valuable although limited to the visual sphere of human experience. The precision of the 2TaLL model simulation has become a source contributing to cautious shaping of space, a true parametric approach which does not negate the humanistic aspect. Although the authors use digital techniques, according to the methodology adopted, results of the research enable producing a wide variety of solutions. Moreover, in a mathematical and objective manner the research defines limitations transposed directly from human perception. I admire the work and hope its authors can continue equally fruitful research.

Visualization of DSM model of Warsaw

The city centre oriented view of Warsaw from the Hoover Square. The visualization was developed using digital height data based on ALS scanning: DSM model of 0.5m, DTM model of 1.0m and orthophotomaps of 10cm pixel. The quality of model enables reflecting basic architectural relations. Its major advantage is a complete representation of all spatial elements with the same precision.

Robert Barełkowski
dr hab. inż. arch., prof. ZUT, UTP
Poznań, 2016-02-10
A picture of a city based on the cloud of points – example of Szczecin

Visualization of DSM model based on Airborne Laser Scanning data at density of 12 points per m². Unprocessed image of a city in the form of a cloud of points can be a basis for using landscape analyses. In the second stage of the project, some of the methods, including VIS and VPS, were adjusted to process DSM models, which required other (recurring) algorithms and software solutions.
Tendencja do rozwoju zabudowy wysokiej w Europie


WPROWADZENIE – OPIS AUTORSKI

CityGML model of a city – example of Frankfurt

Visualization of the city centre of Frankfurt on a basis of CityGML model LoD2. CityGML models are commonly used in Western Europe, in particular in Germany. The standard describes not only the geometry of a city, but contains also semantic information about mutual relationship between elements. The format offers different classes of objects (like buildings, water areas, tunnels, bridges) and various level of details (LoD).
Realizacja głównych założeń projektu

Badania nad zabudową wysoką w ramach projektu 2TaLL prowadzone były dwutorowe. Z jednej strony zmierzyły się do udokumentowania wybranych przykładów lokowania budynków wysokich w miastach europejskich i analizy ich wpływu na krajobraz. Z drugiej strony, ukierunkowane były na stworzenie narzędzi i metod komputeryzowanych służących do symulacji skutków przestrzennych zabudowy wysokiej na krajobraz.

Nowe metody umożliwiają diagnozowanie oddziaływania wizualnego obiektu w postaci modelu 3D na gruncie naukowym. Mierzenie powierzchni pol polarnych wpływów wizualnych. Mierzenie powierzchni pol polarnych wpływów wizualnych i pole powierzchni składowych przestrzeni publicznych (TBL, TBA) pozwala na precyzyjne ustalenie fragmentów budowli czy elementów krajobrazu, które mogą być narażone na przybliżono, czy porównywanie map VIS dla różnych tkanek urbanistycznych stwarza podstawy rozwoju teorii związanej z chłonnością krajobrazu.

Zabudowa wysoka jest istotnym problemem, który nie może być ignorowany. Zabudowa wysoka wpływa nie tylko na krajobraz, ale również na jakość i funkcjonowanie systemu przestrzeni publicznych. Stworzenie optymalnej zastosowania metod w planowaniu może znacząco podniesie jakość i wiarygodność podejmowanych decyzji.

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Opracowane metody analityczne


Metoda Visual Protection Surface (VPS) jest z kolei spojrzeniem na zabudowę jako „negatyw” do „pozytywu” – zera, co jest spójne z założeniami polityki przestrzennej ochrony i kształtowania krajobrazu wielu miast w skali Europy walorach krajobrazowych. W wyniku jednego procesu komputacyjnego otrzymywana jest powierzchnia nad miastem, która definiuje maksymalną możliwą wysokość zabudowy, tak by była ona widoczna z punktów przyszłych wybranych przez autorów w wyniku analizy parametrów geometrycznych (co jest spójne z założeniami polityki przestrzennej i kształtowania krajobrazu w projektach). Obie metody VIS i VPS służą analizie krajobrazu miasta, ale VPS ma szerszą genezę i umocnienie w praktyce. O ile VIS ma szerszą genezę i umocnienie w praktyce, to VPS jest z kolei spojrzeniem na zabudowę jako „negatyw” do „pozytywu”. Zabudowa wysoka stwarza podstawy rozwoju teorii związanej z chłonnością krajobrazu, co w konsekwencji powoduje, że VPS jest metodą od dawna oczekiwana w teorii, ale w praktyce rozpoczęta była dopiero w ostatnich latach.

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Podstawą cyfrowej analizy krajobrazu miasta i badania wpływu budownictwa użytkowego są modele 3D. Uzyskanie dostępu do tych zasobów było niezbędne dla realizacji założeń projektu 2TaLL. Istotnym problemem było również dostosowywanie metody do obowiązujących standardów zapisu modeli. Czynnikami sprzyjającymi są w tym przypadku sukcesy wykonane w ramach Uniwersytetu Europejskiej INSPIRE, które w ogólnym ujęciu nakładają na państwa członkowskie UE obowiązek ułatwiania i zwiększania dostępu do danych przestrzennych. Postęp co do zrozumienia jakości, jak również dostępności danych, jest na tyle duży, że zmiany były zauważalne nawet w czasie realizacji projektu. Często zasobów, które zostały pozyskane na drodze specjalnych umów i porozumień (np. model Berlina), dostrzegano już jako dostępne jako "open source".

W pierwszej fazie realizacji projektu badania były realizowane wyłącznie z zastosowaniem modeli 3D w formie stanowiska CityGML. Najistotniejsze znaczenie ma tu słowo "standard". CityGML uniemożliwia dane 3D do środowiska, w którym model został budowany – co jest kluczową różnicą względem modeli CAD, w których dane są powiązane z określonym programem, a ich transfer do innych narzędzi jest zwykle trudny. Należy ubiegać się o to, w jakim zamierzać są modele 3D w określonym środowisku CAD, jak choćby nowy model 3D Warszawy. Modele CityGML są standardem w krajobrazie, a szczególnie w Niemczech. Wszyscy zasoby nie tylko geometrycznej zabudowy, ale również semantycznej opinii (opisowych relacji między elementami modelu). Format obejmuje różne klasy obiektów (np. budynki, wody, tunele, mosty i ich węzły) oraz ich zapis w różnych skalach dokładności (na listę, np. w przypadku miast niemieckich). Model DSM o nasiętym 0,5 m umożliwia już zapis podstawowych relacji architektonicznych. Kluczową zaletą takiego "obrazu" jest kompletne odkrywanie wszystkich elementów przestrzennych na podstawie doświadczanek. W drugiej fazie realizacji projektu część z metod, w tym VOS oraz PFS zostało dostosowano także do przetwarzania modeli DSM, co wymagało zupełnie innych (rekrutacyjnych) algorytmów i oprogramowań. Badania użyciem modelu CityGML były prowadzone dla 4 miast w Polsce: Warszawy, Szczecina, Lublina i Wrocławia.

Wymiana i rozpowszechnianie wiedzy oraz perspektywy kontynuacji badań

Reализacja projektu 2TaLL wymagała intensywnego podjęcia:

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2TaLL: Cityscape analysis, Exchange of knowledge and dissemination of results
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Exhibition of the research project 2TaLL
Application of 3D Virtual City Models
in Urban Analyses of Tall Buildings

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