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THE PHENOMENOLOGY AND PHILOSOPHY OF SIMULACRA INFLUENCE ON THE VR

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Abstract
Presented paper is divided into two parts. The first part concerns the main philosophical aspects of Virtual Reality. At the basis of the J. Baudrillard theory of aesthetic simulacrum the differences between imitation and simulation are considered. The M. Heidegger's notion of "lifebeing", Dasein and nature are presented. In the second part, Virtual Reality is analysed from two points of view – as a tool for presentation and as an environment for direct designing in the virtual world.

Keywords: simulation; phenomenology; Virtual Reality

1. PHILOSOPHY AND VR

In the post-modern era the electronic picture is the predominant force defining its figurative character. Emergence, development and scales of impact of the emitted reality define a new era. It is saturated with pictures in the degree which was not observed in history. Discussion goes on not about aesthetic and technological problems, but about emergence of a new type of culture. In time of the images, emitted by television and being an integral part of computer games and animations, as well as representations of the simulated virtual worlds, socio-cultural conditions for expansion of human practice on the unknown space of cultural experience are created.

The paradoxical logic of representations and ideology of "simulation" is formed.[1] According to Turkle, we observe the transition from modernist culture of calculating to post-modernist culture of simulation. Architecture begins to exist in other dimensions, other spaces. [2]

The concept of simulation is important for virtual reality systems creation. This concept is closely related to the Jean Baudrillard concept of "Simulacra". Simulacra (Simulacres in French means: stereotype, a pseudo-thing, an empty form, a blank form) is one of the key concepts of postmodern aesthetics, has the place belonging to "image" in classic aesthetic systems. Sim-

[1] The notion of simulation occurs in the 60s of the twentieth century in the works of R. Barthes and A. Lefebvre. However, its active use is associated with the name of Jean Baudrillard, who in his book „Simulacra and Simulation" has introduced the term simulation into cybernetics (where it meant modelling and simulation of reality) and applying it for a critical analysis of modern industrial society. The development of modern technology conducts, according to Baudrillard, a radical change in the status of a sign. Due to the globalization of the exchange processes, on the one hand, and the mass popularity of television, video and computers, on the other, signs cease to be a representation of some external reality. Modern world is a world of infinite circulation of signs, where the referent behind the sign cannot be accurately indicated, to connect the „signify" and „signified". (Such signs Baudrillard calls „simulacra".) With the development of new medial signs „absorb" an object and create a hyper-reality, in which the distinction between „real" and „imaginative" is blurred.
[2] S. Turkle, Life on the Screen. Identity in the Age of the Internet, Simon, New York, 1995.
[3] J. Baudrillard, Simulacra and Simulation, University of Michigan Press, 1995.
[4] S. Žižek, The Plague of Fantasies, Verso Books, 2009.
[5] M. Heidegger, *Bycie i czas,* Wydawnictwo Naukowe PWN, Warszawa, 2013.

ulacrum is an image of absent reality, a plausible similarity devoid of the original (deprived of the original), superficial, hyper-realistic object behind which any reality is not necessary. It is an empty form, self-referential sign, artefact that is based only on own reality.

Jean Baudrillard, whose theory of aesthetic simulacra is the most representative, defines it as „pseudo-thing" replacing „agonizing reality" with „post-reality" by simulation, which is giving out absence for presence, blurs the distinction between the real and imaged. We observed how the reflection of reality is replaced by its deformation, then by masking of its absence, and finally – it loses of touch with reality. Meaning is replaced with an anagram, visibilities - by simulacrum. We can say that the simulation is to create a simulacrum.[3]

In the postmodernist ontology the term of Simulacrum is also considered as a method of registering of a potential event ("eventness"), which is realized in the act of semiosis and has no other forms of being besides perceptive – symbolic. From the epistemological point of view this term is interpreted as a way for designation of transgressive experience, being beyond men's possibilities of conscious reasoning. Simulacrum goes back to the term "simulakrom" denotes Plato's "copy of a copy". In the situation of total rejection of the idea of references postmodernism radicalizes the interpretation of simulacrum. Postmodern philosophy sets cogitative space where the identity of the image and likeness of copies will delusion. Simulacrum, in this context, is defined as an exact copy, the original of which has never existed. It is a particular means of communication, based on the reconstruction, during verbal communication, of purely connotative meanings of statements.

The key for the concept of virtual reality is the difference between imitation and simulation. Virtual reality does not imitate reality but simulates it and generate its visibility (similarity). In other words, the imitation mimics the existing model, taken from real life and simulation generates a kind of non-existent reality. An example is the virtual memory of a computer. A computer can simulate and act as if it has much more memory than it actually does. The implication of the differences between imitation and simulation is much more radical than we think. In contrast to simulation supporting the belief in the existing reality, simulation waives the existing reality. It assumes that there is no difference between the world and its artificial representation.[4]

As in reality, when in virtual space a man raises his hand to move an object, this object actually moves. The man does not notice the complex mechanism of computer coordination. Moreover, he makes no effort to understand how the computer operates and agrees that, in interaction with the virtual space, his situation is similar to his ordinary life where he acts by trial and error.

Turkle claims that "we take things as their interface value - we take things at their face value". This thesis encompasses (comprises) a phenomenological approach according to which the main features of cyberspace are the same as M. Heidegger's fundamental features of our common "lifebeeing" (in-der-Welt-sein). Men are in a situation where the coordinates are not regulated by clear universal principles and therefore they should gradually looks for in their own way for goal achieving. For understanding of VR, Heidegger's terms of Dasein, which means existence (Da) turns into a being (Sein) or Dasein is the Being for whom being is a question, and interpretation of the nature are equally important. Heidegger negates the nature and claims that nature may exist only if it is understandable and usefulness (Zuhandenheit).[5]

2. VIRTUAL REALITY IMPLEMENTATIONS

As already mentioned, the technology of virtual reality provides the possibility of modelling real situations and creating a digital world that does not have its reflection in the physical space and is intended for "digital activity."

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[6] H. Regenbrecht and D. Donath, *Architectural Education and Virtual Reality Aided Design (VRAD)*, In D. Bertol (ed.). *Designing Digital Space - An Architect´s Guide to Virtual Reality*, pp. 155-176. Wiley & Sons, NY, 1997, p. 155

[7] P. Virilio, *Cibermunde; la politique du pire*, Editions Galilee, Paris, 1978

[8] P. Queau, *Le Virtuel, vertus et vertiges*, Champ Vallon, Paris, 1993

[9] A. Bridges, D. Charitos, P. Rutheford, *Wayfinding, Spatial Elements and Spatial Support Systems in Virtual Environments*, In A. Asanowicz, A. Jakimowicz (eds.) *CAAD - Towards New Design Conventions*, Bialystok, 1997. pp. 75-104

[10] J. Bermudez, *Defining Architectural Experiences*, In Proceedings of ACADIA Conference, Seattle: University of Washington, 1995, pp. 139-149

[11] P. Anders, *Anthropic Cyberspace: Defining Electronic Space from First Principles*, In Proceedings of 3rd SIGRADI Conference, Montevideo, 1999, pp. 55-67

[12] H.H. Achten, B. Vries de, J. Jessurun, *DDDoolz – A Virtual Reality Sketchtool for Early Design*, In Tan B-K, Tan M., Wong Y-C. (eds.), Proceedings of CAADRIA Conference, Singapore, 2000, pp. 451-460.

[13] N. Segers, *Computational Representations of Words and Associations in Architectural design. Development of a System Supporting Creative Design*, Eindhoven University of Technology, 2004.

"The virtual world can be defined as an element of communication that takes place in a computer-generated synthetic space and includes people (actors) as an integral part of the system. The main components of the system - a set of hardware and software, provide to actors a three-dimensional, or even a multi-dimensional space of input-output of data. In this space they, at every moment, can interact in real time with other autonomous objects. (...) Communication in the virtual world is determined by individuality of each actor, his sensory-motion experience, as well as the relationship between information, navigation, orientation, and various forms of the user expression."[6] The main goal of VR is to create the possibility of space test by its user. This is not possible without active user behaviour. Thus, the virtual space of interaction should correspond to the real space, and be large enough to allow moving in it, that is, it should be an architectural space.

In recent years, great efforts aimed at research and implementation of VR techniques in architecture is undertaken. Many works discuss virtual modelling as another kind of architectural activity. But we should remember that when designing a virtual environment it is necessary to account for its own digital characteristics, as it differs from the real environment. With regards to this, the perception of virtual environment also differs from real world perception. This difference was analysed by many researchers.

Many studies emphasize the spatial heterogeneity of VR, the speed and shortening the distance[7], the linguistic capacity and susceptibility of images[8]. Therefore, approaches to create virtual spaces contain spatial and acoustic recommendations[9]; include travel chronicles[10], anthropological factors[11]. We can say that they considered the look, semantics and behaviour of digital systems according to the main cognitive questions: "What is it?", "What does this mean?", and „What can I do?". If you take these questions to virtual architecture, they define the relationship between the function of the building and human activity in the virtual space. The composition is aimed at communication of values, and structural aspects are replaced with the visual expressiveness of computer tools.

In the process of creation of virtual spaces the time factor – chronology – is very important, as graphical means are no longer adequate for design of the digital environment. It must be filled up with story or scenario describing the algorithm of management of information integrally related with the three-dimensional model. Creating such complex environment, including space, story and interaction, it is necessary to consider the aspects defining the difference of virtual forms from physical models: the dominance of internal perception frames, separation, imposition or intersection of elements, complex shape without structural basis.

It demands redundancy, which means an inclusion of sound and other multimedia tools of coordination in the environment. This is due to the fact that the point of reference of the **space** is not man's body but his mind, which becomes the basis for coordination of visual perception, semantic interpretation and motion activities. Despite the fact that virtual world can be quite abstract, its recognition and main perception characteristics (hierarchy, shape, and background) are still important.

One of the most important aspects of the direct design method is the way of human – computer communication. For this purpose a more convenient, for practical use, method is needed. It should be clear, use traditional notation and terminology, convenient to use and easy to learn. The main principle of the "direct design" method is a total immersion in the projected environment. Architect as "cybersculptor" works in the natural scale (scale 1: 1). He is within the projected space, defines the direction of changes and interactively implements these changes, moving forms in virtual space. Designing in the virtual space, the designer is "IN" a full three-dimensional space. He can interactively create space, filling it with volume forms. There are no obstacles for designing in the virtual space, which is a full-scale space. One of the first programs allowing sketching directly in a virtual environment was DDDoolz[12], PolyShop[13], HoloSketch[14], Sculptor [15] and VRAM[16].

The review of these computer programs shows that one of the main issues that determine the effectiveness of the designer, is the problem of complexity of management. There are difficulties with the interface. Manipulation of forms in a virtual space requires a different control system than that used in conventional computer programs. Moreover, it appears that the virtual manipulators (spatial mouse, a digital pen) works inaccurately when it is necessary to move "voxel" (spatial equivalent of a pixel) in the virtual space.

[14] M.F. Deering, *The HoloSketch VR Sketching System*, In Communications of the ACM, 1996, 5, pp. 54-61.
[15] D. Kurmann, *Sculptor – A tool for Intuitive Architectural Design*, In M. Tan, R. The (Eds.), The Global Design Studio, Proceedings of CAAD Futures'95, University of Singapore, 1995, pp. 323-330.
[16] H. Regenbrecht and D. Donath, *Architectural Education and Virtual Reality Aided Design (VRAD)*, In D. Bertol (ed.). Designing Digital Space - An Architect´s Guide to Virtual Reality, pp. 155-176. Wiley & Sons, NY, 1997.

Condition for the effective functioning of cyberspace is a natural (human) way to work in it. This can be achieved only when using the full semantic set of the natural methods of communication, including verbal means. N. Negroponte in his book "Digital Life" has written: "the idea is simple: talking, pointing and seeing should jointly create a multimodal interface that less will operate on the transmission of messages to and from (time-sharing interface mode) but rather will remain human face to face conversation".[17]

Such a change in the interface becomes possible due to the increase of computer performance. We may include speech recognition software based on artificial intelligence into the simulation control system, which will create the most natural way of human - computer communication.[18]

CONCLUSION

The development of computer technology has created the possibility of creation of computer-generated multisensory environment, as a means of presentation of architectural ideas and as the environment in which these ideas are embodied.

Systems of virtual reality are even more often used in modelling, presentation and evaluation of three-dimensional forms. Thanks to virtual reality, digital world is not a two-dimensional television space but a three-dimensional world completely controlled by man. Man exists in three dimensions, feels real time, and enters into a relationship with the world around him. The architectural design of the presence within the virtual world may be realized in three ways: using a virtual helmet, semicircular screen or "virtual CAVE". So VR and cyberspace open up new aspects of human perception and cognition.

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APPLICATION OF 3D VIRTUAL CITY MODELS IN URBAN ANALYSES OF TALL BUILDINGS – TODAY PRACTICE AND FUTURE CHALLENGES

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Abstract
The complex geometry of the city structure and the increasing speed of ongoing urban transformations in large European cities, requires powerful tools for the analysis, design and management. Virtual 3D city models can be an important tool in urban planning, used to diagnose phenomena produced by tall buildings. In recent years, the issue has become a considerable challenge for the cohesion of the European urban landscape. This paper presents foundations of a research project under Polish-Norwegian financing mechanism called 2TaLL. The project examines possibilities and limitations of using virtual 3D models of cities to provide advanced urban analyses focused on simulating impact tall buildings have on landscapes of European cities. The research is an interdisciplinary combination of geo-information and urban planning and contributes to the development of theory & applications in the two fields of engineering science.

Keywords: 3D virtual city models; 3D analysis; tall buildings; city complexity; urban planning

1. TALL BUILDINGS PHENOMENA IN EUROPE

In contemporary Europe tall building phenomenon creates very up-to-date problem. It appears to be one of the most challenging issues in spatial planning. On our continent, many cities allowed tall buildings to be developed in their centers. The trend of building high is very strong in such historical cities as Milan, Vienna, Paris, Brussels and London, as well as Köln, Frankfurt and Amsterdam. The phenomenon has become quite common not only in the largest capital cities but also smaller towns with population below 500 thousand. This signifies a major ideological impact of tall buildings and global aspirations of those cities. Contrary to other continents, Europe has historically established spatial values which strongly contrast with tall buildings. Therefore, the planned height of buildings is subject of discussions, conflicts and controversies in each city. On the one hand, we attempt to maintain the climate and atmosphere of a city based on historical scale of buildings, habits among inhabitants, and conservation of existing buildings, and on the other, we tend to maximize investment return in valuable and important locations as well as interpretation of tall buildings as symbols contributing for creating a contemporary image of a city and prestige of its owners. However, tall buildings either clustered in one district or scattered within the city structure remain in strong contrast to historical buildings. Moreover, due to their scale and distinguished architectural form, tall buildings have strong visual impact. Therefore, in order to protect valuable urban and architectural development, their location in a city should be determined on the basis of prior in-depth analyses of impact tall buildings have on the urban landscape. In many instances, negative consequences of an inappropriate location of a tall building result from inability to foresee its spatial impact.

2. TALL BUILDINGS ANALYSIS VERSUS ANALOG URBAN PLANNING

Space in a number of European cities reveal planning errors in terms of locating tall buildings. An obvious and clear example of the above is Tour de

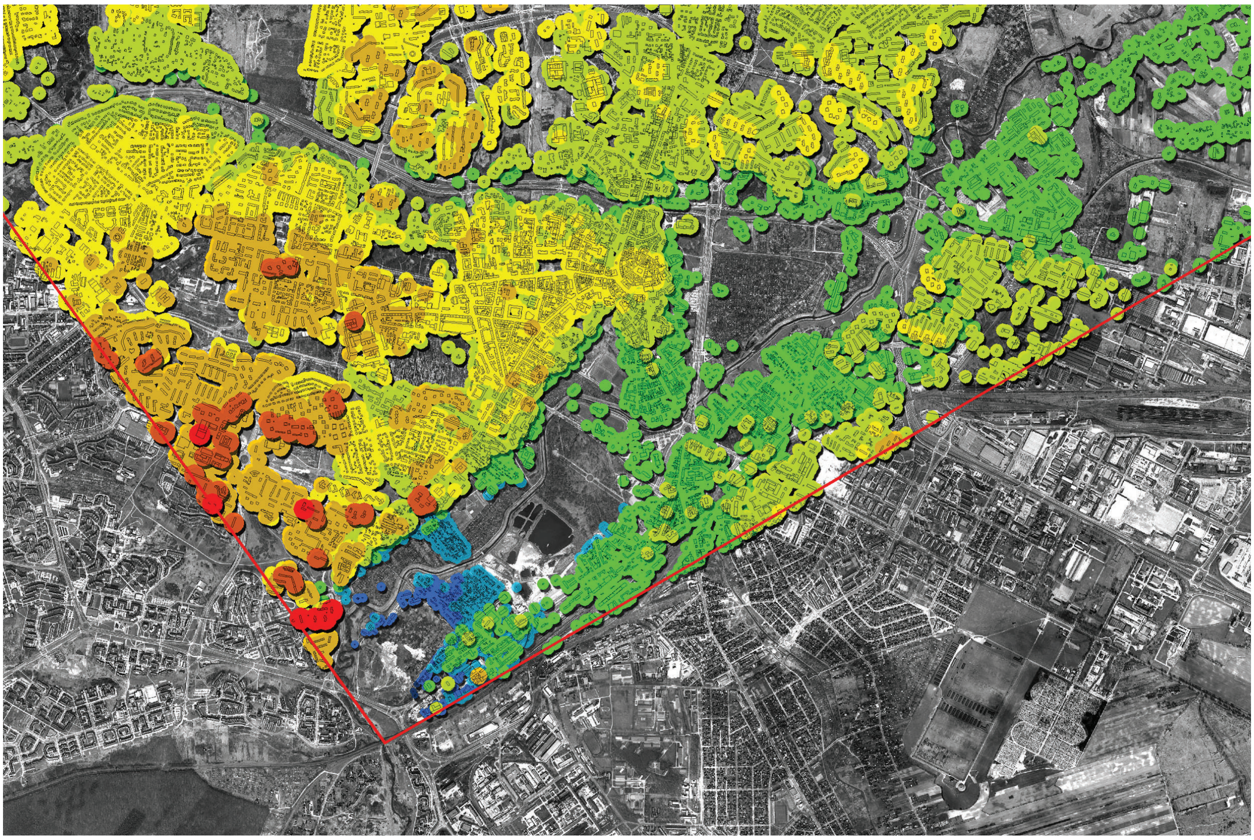

Fig. 1. Analysis of view angles for selected panoramas of Lublin (Poland) – angles characterize relationship between viewpoint and buildings in city (figure by author 2011)

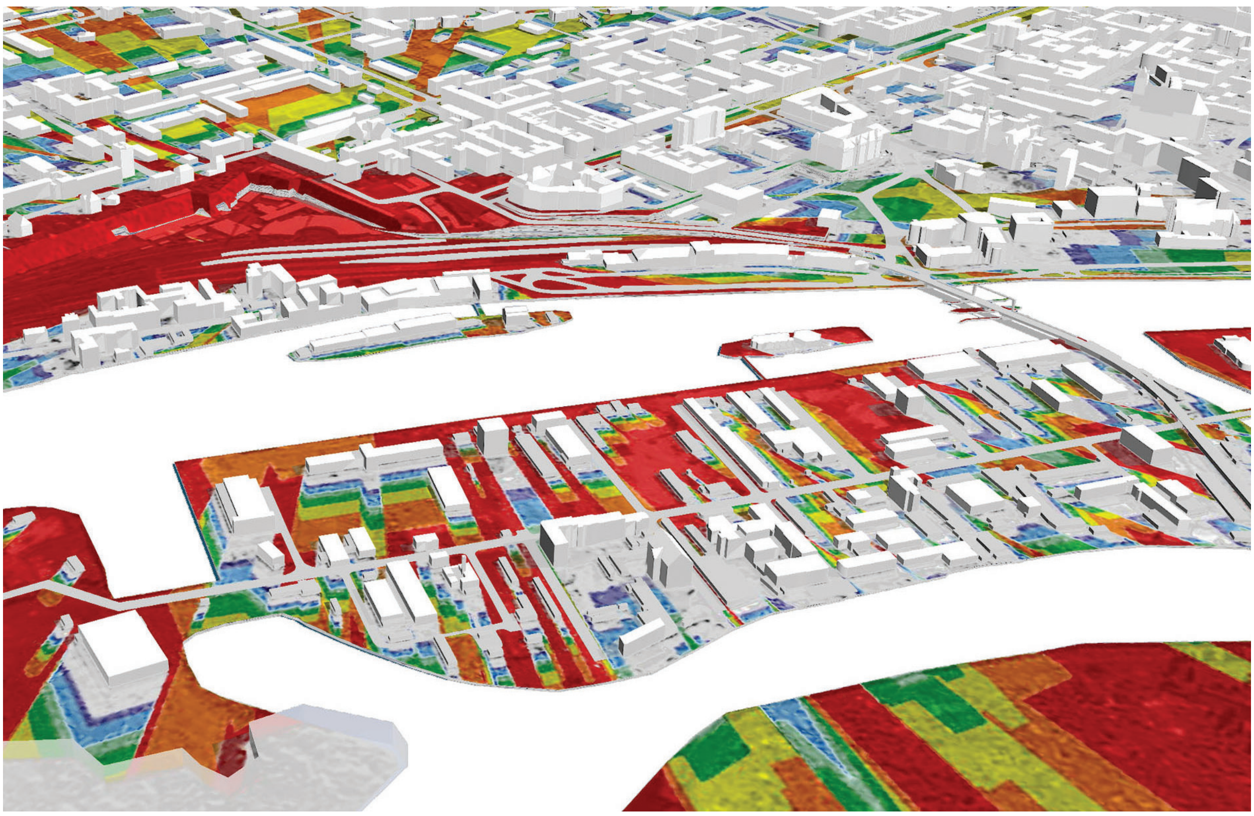

Fig. 2. Analysis of visual impact of tall buildings in Szczecin based of virtual 3D city model. Analysis illustrates in color form which height tall object is visible in space (figure by author 2014)

Montparnasse in Paris, built in the 70s of the 20th c., which distorted the axis of Champ-de-Mars seen from the foot of the Eiffel Tower. Unfortunately, such examples are many all over Europe and the same also applies to buildings erected recently. In the 20th c., when the first tall buildings were built, the tool kit of an urban planner was limited to traditional tools, such as sketches and individual cross sections. Professionals could resort to their experience and intuition only. Thus, a number of design errors were made. Contemporary computer-assisted tools and media provide for objective and thorough analysis and simulation of complex urban conditions. The examination of visual impact of tall buildings is complicated from a geometrical point of view. The use of computer-assisted techniques facilitates and expedites the process of defining guidelines for erecting tall buildings.

Several cities have developed methodologies to provide guidance for selecting locations of tall buildings. The system of supervision developed for the London landscape is in the forefront. A comprehensive system of assessing and selecting city views was developed supported with detailed description of advantages of the existing landscape which needs to be protected[1]. This is accompanied by a system of verifying planned tall buildings by simulating their impact in selected strategic views: London Panoramas, River Prospects, Townscape Views and Linear Views[2]. Computer aided techniques have also been used to develop guidelines for protecting landscapes of such cities as Warsaw[3], Ottawa[4] and Dusseldorf[5]. However, the virtual model of a city was used for simulating and visualizing guidelines rather than a research tool. The model can also become a basis for a very precise and objective analysis, extending far beyond simple drawing/visualizing of a concept. Effects of such a use of the model are frequently surprising and hardly predictable. Figure 1 and 2 are an example of such analysis results. The geometry of the areas of visual impact of a building and calculation of view angles for all buildings in a city could not be achieved by traditional drawing techniques.[6]

3. APPLICATION OF VIRTUAL CITY MODELS

The progress in geo-information research and related development of new techniques of visualization of urban landscape is extremely dynamic. The development of LIDAR techniques, aerial photograph processing techniques, new software solutions and general development of computer technologies enable automation and improvement in modelling of the built-up environment[7]. The majority of large European cities have their 3D virtual models already developed. The key issue for further development in the field was introducing recently of CityGML as an open standard for data recording[8]. The advancement in modelling techniques and visualization is ahead of their application. Virtual models of cities can be viewed on-line. They are used for developing infrastructure and services, commercial sector and marketing, promotion and collecting information about cities (e.g. promotion, tourism, visualizations for investors, etc.). To a certain extent, they are also used for selected specialist analyses (e.g. acoustic analysis, simulation of disasters and traffic management)[9]. To a lesser degree, virtual models are used directly in urban and spatial planning and related to them advanced urban analysis.

In recent years, we have seen the development of computer programs for optimizing and creating maps, obtaining and processing spatial information, etc.[10] Also developed are simple and intuitive applications for obtaining a simple map/visualization of the viewshed for a particular point in space. Google Earth Pro provides a tool to visualize the field in the 3D models available on the platform[11]. There are also a numerous applications that allow to calculate a single 2D isovist[12] (e.g. for AutoCAD). However, the advancement is not followed by theoretical knowledge which could indicate directions of their use by architects and urban planners. Computer simulation like an isovist map itself is not sufficient for the assessment of planning guidelines. The process of reaching a proper solution can be compared to the interpretation of an X-ray image by a medical doctor. It is one of elements helping in diagnosing of the disease.

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[9] S. Pal Singh, op.cit. p. 86.
[10] For example: AutoCAD Map 3D (Autodesk), ArcGIS (ESRI), MapInfo (Pitney Bowes).
[11] Option "Show viewshed" is available only in version of Google Earth Pro.
[12] A single isovist is the volume of space visible from a given point in space. M. Batty (2001), Exploring isovist fields..., pp. 123-125.

There is a need for developing a scientific approach, knowledge of the spatial structure of the city and adequate supply of expertise that enables a proper evaluation and interpretation of the resulting viewshed. It is necessary to develop theoretical knowledge in this field dedicated for urban planners.

3.1. Objectives of 2TaLL project.

Relevant research is carried out by the 2TaLL project (Application of 3D virtual city models in urban analyses of tall buildings) funded from Norway Grants. The project is implemented by a team of researchers called the Cyber Urban Center at the Department of Civil Engineering and Architecture at the West Pomeranian University of Technology.[13] The research is based on previous scientific and practical experience of the author. Some theoretical work was developed during preparing studies implemented by the author in Szczecin and Lublin and commissioned by the two cities. The studies focused on city space and tall buildings[14], and finding suitable locations for such buildings from the point of view of the city composition and defining specific parameters of tall buildings in Szczecin[15]. The study for Lublin focused on examining and defining principles for protecting city landscape values.[16] Each of the two studies involved using computer assisted techniques and a virtual city model. Each time, the set of tools was adjusted to specific research needs. The experience was described in the doctoral thesis of the author[17] and other publications[18]. A typical basis consisted of five analytical techniques: height structure analysis, view angle analysis, view range analysis, panorama simulation using height lines as well as analyzing the visual impact of a building[19]. The methods enable precise and objective analysis of the city structure, defining parameters of new buildings and determining zones were tall buildings should be excluded.

The 2TaLL project aims at developing both theoretical and practical knowledge to optimize diagnosing of tall buildings impact. The project combines several research areas. The use of virtual city models as an analytical tool creates possibilities of improved forecasts regarding the spatial impact of tall buildings on the city landscape, including impact on panoramic views and sequences of urban interiors and important public spaces (perception of tall buildings). The research is going to be based on four virtual city models for Szczecin, Lublin, Berlin and Frankfurt. The models will be adjusted to provide for complex analyses of the urban space. For this reason, special applications will be developed. The applications will be used to implement specific research tasks related to typology of public space and impact of tall buildings.

The research is divided into two theme blocks: a theoretical part aimed at expanding knowledge about the status of research and background of the issue. Other planning studies related to the topic will also be developed. The research additionally includes studies documenting the actual location and visual impact of tall buildings in the largest European cities. The project is expected to develop a methodology for new research techniques. The practical part will include an analytical basis for spatial analyses: optimizing 3D models of new cities, preparing new computer applications and testing available GIS and CAD software (e.g. ArcGIS 3D Analyst). The research is designed to produce a comprehensive methodology facilitating diagnosis and simulation of tall buildings impact (3D Urban Analysis Systems of tall buildings) to protect valuable city landscapes.

CONCLUSIONS

For architects and urban planners, the use of a digital picture of 3D urban space creates completely new analyzing and designing opportunities. It provides unique results that are not available in the case of classical research techniques. The visualization of design and planning concepts in the broader 3D context provides for more suitable solutions. However, the virtual modelling of cities is still in its fledgling stage and possibilities for applying it in urban planning have started

[13] Zespół w składzie: Professor W. Marzęcki and Doctors K. Czyńska, P. Rubinowicz, A. Zwoliński. Głównym celem jest rozpoznawanie na gruncie naukowym potencjału aplikacyjnego „cyfrowego obrazu miasta" w procesie planowania i w kreacji urbanistycznej. More in: P. Rubinowicz, Cyber Urban Design, Archivolta 3(59)2013, pp. 58-65.

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[20] J. Moser, F. Albrecht, & B. Kosar, Berlin 2010, p. 143-147.

to be examined. The community of professionals and researchers in the field of architecture and urban planning should be more involved in the development of the specialist knowledge. In the future, virtual city models can be an important tool in urban planning[20]. One of possible uses is the planning of locations for tall buildings and protecting historical city landscapes. The models can form a platform coordinating interdisciplinary research leading to better management of city spatial development.

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REAL TIME GESTURE RECOGNITION IN 3D SPACE USING SELECTED CLASSIFIERS

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Abstract:
In this paper, authors propose a solution to track gestures of hands in 3-dimensional space that can be inserted into a CAVE3D environment. Idea of gestures recognition system is described and the results of research made on a recorded gesture data. In this study three selected classifiers to resolve this problem have been tested and results compared.

Keywords: 3-dimensional space; gesture recognition; CAVE environment

INTRODUCTION

In this paper, authors propose a solution to track gestures of hands in 3-dimensional space that can be inserted into a CAVE3D environment. Solution is based on the use of gestures for this purpose. A system consists of two main parts: a tool for gesture recognition and a graphical environment in which the user can see objects moved in three dimensional space and control them using gestures. Authors describe the idea of recognition system and present the results of research made on a recorded gesture data which contains 12 gestures, 80 repeats each, which gives summary 960 instances of gestures. In this study three selected classifiers to resolve this problem have been tested and results compared.

1. RELATED WORK

The problem of gesture recognition, especially in three dimensional space, is well known. There exist many other works related to this research where authors show different ideas of solving this problem. Some of them concentrate only on body parts motion (mainly hands), other use also different kind of information about gesture, for example received from images (like hand posture and shape). In [1] authors were using theory of random propagation and formulated gesture recognition problem as an $\ell 1 \ell 1$-minimalization. Their system operated on 3-axis accelerometer. Similar accelerometer was used by authors in [2]. It was transmitting collected signals to personal computer by a bluetooth protocol. Gesture data was reduced to 8-bit numbers and recognized using algorithm based on sign sequence and template matching. Description of successful attempt of using genetic programming to recognize gestures was presented in [3]. A position invariant gesture recognition real-time algorithm based on dynamic time wrapping was described in [4]. Another idea of gesture recognition was using bayesian networks. Method proposed in [5] is using such networks and is based not only on dynamic hand moves, but also hand posture.

A popular way of obtaining gesture data is using depth images. Such kind of images are possible to obtain for example from Microsoft Kinect sensor [6], which also was used as a data collecting device in research presented in this paper. Many authors also used the same sensor in their works. In [7], authors were using depth images to detect gestures, which were classified by decision forest made of several multiclass support vector machine algorithms. Another popular way of performing gesture recognition with Kinect is using Hidden Markov Model. Authors in [8] checked how it works and tried to improve HMM-based solution. In [9] another HMM-based method of recognizing single hand gestures in three dimensional space is described.

In our publication we present our novel idea of solving the problem of gestures recognition.

2. GESTURE RECOGNITION METHOD

2.1. Requirements

To understand what are the requirements of a proper gesture recognition let's describe a hypothetical scenario. The user is at the center of a region of some virtual representation of three-dimensional space – this can be for example a CAVE3D environment. In front of the user and in his left and right, big screens are located that view images, resembling a 3D space (see Figure 1). The user can perform gestures that can be interpreted by a gesture recognizer to achieve predefined actions. Such an action can be for example a new object creation. When such gesture is recognized, the user should see a new object on the front screen. User can also perform other actions, for example he can move an existing object using different gesture, drop the object by another one, and so on. After taking a look at such scenarios, there are several basic requirements of a gesture recognition algorithm:

- gesture recognition should be performed in a real time,
- ability to recognize at least a few different gestures,
- ability to define a new gesture,
- ability to learn defined gestures.

Authors noticed that the problematic part of such approach is the need of a real time processing of detected gestures. The user should be able to perform gesture at any time, without worrying whether the program will recognize it or is now processing previous data.

The tool inserted into CAVE3D environment should also allow recognition of different gestures. For example, there should exist at least gestures to: create, drop or release, move, delete objects, but also control the space anchor point (where the user is positioned). Also, we can consider creating a number of other gestures to achieve more advanced tasks, for example modifications of objects shape (bending, scaling) and many others.

In overall, depending on requirements, the user should be able to define his own set of gestures that will be responsible for specific functionalities. This can be achieved by allowing the user to record a series of gestures and marking them individually by a defined label. Recorded gestures are the training data set for classifiers.

Fig. 1. Cave3D, source: http://www.bialystokonline.pl/gfx_artykuly/201211/67014.jpg, 18 Feb. 2014

2.2. Gesture tracking equipment

For the purpose of gesture tracking, authors decided to utilize a well-known Microsoft's solution called Kinect [10]. Kinect has a camera for detecting the field depth, which provides support for the third dimension – camera captures gray scale images of the field, in which the intensity parameter defines depth. Kinect has also the ability to track human body skeleton, so that fact allowed authors to focus on the gesture recognition algorithm rather than image analysis.[1]

Motion detection with the help of the Kinect controller is based on the detection of characteristic points of a whole person body in its range. Despite this, au-

[1] Note, that Kinect has also a very basic and limited set of gestures that can be automatically recognized. That feature was not used in this work.

thors limited gesture tracking to the points representing the user's hands only.

2.3. Data representation.

The data has to be represented in a normalized way that can be properly interpreted by the classifier. This representation should be resistant to minor differences between successive repetitions of gestures, the distance of the user from the camera, etc. Therefore, it is not useful to record position of the hand directly.

Considering above, the authors decided to store a relative representation of successive recorded samples, not direct positions. Each sample consists of three numbers - dimensions: X, Y, Z. Each subsequent sample is the distance from the previous sample within each dimension. Subsequent samples represent the direction and speed of movement of the hand in three directions in relation to the previous recorded sample. As a result, the entire gesture consists of a set of values (see Fig. 2).

$X_2 - X_1$	$Y_2 - Y_1$	$Z_2 - Z_1$	$X_3 - X_2$	$Y_3 - Y_2$	$Z_3 - Z_2$	...	$X_n - X_{(n-1)}$	$Y_n - Y_{(n-1)}$	$Z_n - Z_{(n-1)}$

Fig. 2. Representation of a recorded gesture consisting of n samples, source: by author

2.4. Implementation of gesture recognition in real time.

To achieve gesture recognition in real-time an author's own method of detection of the beginning and end of the gesture was utilized. The method is based on the assumption that it is not relevant when the user begins to perform gesture - what counts is the moment when there's an end of its execution. Termination of the gesture occurs when the user pauses the movement of the hand for a set number of recorded samples. The detected gesture is a set of samples (a motion) performed just before the acquisition had stopped.

To solve the problem of recognition authors decided to utilize classifiers. Selection of the classifier is crucial, considering that not only the accuracy can change, but also speed of learning and recognition processes. Three classifiers have been evaluated in this research to find one that fits best in our experimental requirements:

- Artificial feed-forward neural network with back-propagation learning (Multilayer Perceptron, MLP) [11]

In this work, authors used a network, where the input represented by samples of a given gesture (and therefore the length of the input is equal to 3 (dimensions) times the number of samples). Network consists of one hidden layer having a length

$$\frac{\text{the length of the input layer} + \text{the length of the output layer}}{2}$$

$$\frac{\text{the length of the input layer} + \text{the length of the output layer}}{2}$$

and the output layer with a length equal to the number of possible gestures to recognize. Each output represents one class of the gestures, a number in the range of $[0,1][0,1]$that represents validity of associated gesture to that output. Gesture is considered recognized, when value of the output is close to the value of 1.

The neural net is known to properly learn non-linear solutions on ill-defined problems, but the training procedure becomes slow on large datasets.

- Support Vector Machine, SVM [12]

SVM maps input space into high-dimensional feature space constructing a hyperplane that divides two classes of objects. Function that performs that mapping is known as a SVM kernel function. The training example set $\{(\vec{x_1}, y_1) \dots (\vec{x_k}, y_k)\}\{(\vec{x_1}, y_1) \dots (\vec{x_k}, y_k)\}$ represents input space and $y \in \{-1, 1\} y \in \{-1, 1\}$ represents two classes, is mapped into feature space in which the mapped training examples are linearly separable. Divided space can be used for classification of new data objects and the best separation is achieved by a hyperplane that has the largest distance to the nearest training points of all classes. Generally speaking, maximize:

$$W(\alpha) = \sum_{i=1}^{k} \alpha_i - \frac{1}{2} \sum_{i=1}^{k} \sum_{j=1}^{k} \alpha_i y_i \alpha_j y_j K(\vec{x_i}, \vec{x_j})$$

subject to

$$\sum_{i=1}^{k} \alpha_i y_i = 0, \alpha_i \in [0, C], i = 1, \dots, k$$

Where $K(\vec{x_i}, \vec{x_j}) K(\vec{x_i}, \vec{x_j})$ is a dot-product SVM-kernel function. Many different kernel functions were proposed in the past: linear, polynomial, sigmoid and the Radial Basis Function (RBF): $K(\vec{x}, \vec{x}') = e^{-\gamma \|\vec{x} - \vec{x}'\|^2}$ $K(\vec{x}, \vec{x}') = e^{-\gamma \|\vec{x} - \vec{x}'\|^2}$ are most popular.

Authors utilized a multi-class SVM [13] for the purpose of multiple gestures recognition, thus the output of the classifier is a single integer in the range $[0, number\ of\ gestures - 1]$ $[0, number\ of\ gestures - 1]$ that represents the gesture recognized.

- Radial Basis Network [14]

RBN differs from standard neural network in its hidden layers structure. Radial basis function network has only one hidden layer which uses radial basis func-

Tab. 1. Sample research result: SVM, linear kernel, without normalization.

Gesture	O	\	/	(	)	8	|	~	^	<	-	>
O	98,09	0,00	0,00	0,00	0,00	1,66	0,00	0,00	0,00	0,26	0,00	0,00
\	0,00	99,61	0,00	0,00	0,00	0,00	0,39	0,00	0,00	0,00	0,00	0,00
/	0,00	0,00	91,85	2,19	0,24	0,00	5,60	0,00	0,00	0,00	0,12	0,00
(	0,00	1,23	0,12	84,94	0,00	0,00	3,70	0,00	0,00	10,00	0,00	0,00
)	0,00	0,00	4,19	0,00	88,18	0,00	2,59	0,00	0,00	0,00	0,00	5,05
8	5,36	0,00	0,00	0,12	0,00	92,52	0,00	2,00	0,00	0,00	0,00	0,00
|	0,00	1,94	4,52	10,06	3,35	0,00	76,65	0,00	0,13	1,94	1,16	0,26
~	0,00	1,52	0,00	0,00	0,00	0,00	0,38	92,25	5,84	0,00	0,00	0,00
^	0,00	3,49	0,36	2,53	0,36	0,00	0,48	1,08	90,49	0,24	0,96	0,00
<	0,00	2,34	0,99	7,52	0,37	0,86	4,32	0,00	0,00	83,60	0,00	0,00
-	0,13	0,00	7,29	0,00	0,26	0,00	0,13	0,00	0,00	0,00	91,82	0,38
>	1,24	0,00	1,74	0,00	15,65	1,49	0,87	0,00	0,00	0,00	2,98	76,02

source: prepared by authors

Tab. 2. Results of measurements obtained using selected classifiers

Classifier	SVM	NN	RBN
Mean recognition accuracy	91,74	90,65	82,92
Mean standard deviation of the accuracy	5,89	5,86	8,27
Calculations Time	274,69	5193,10	376,88

source: prepared by authors

tions as activation functions. The input layer and the output layer structure is designed the same way as neural network. It also uses the same kind of normalization and gives results in the same format.

3. RESULTS AND DISCUSSION

For accuracy testing purposes and to achieve best results in gestures recognition problem, authors performed several experiments with collected gestures data. These include 12 gestures recorded as values in format described in section 3.3. The study checked the effectiveness of the classifiers, primarily to identify accuracy in different gestures recognition, as well as speed of calculations. Collected data were randomly divided into training data (80%) and testing data (20%). Classifiers have been taught using training data, then testing data have been classified. Such operation was repeated 50 times, then averaged.

Example results of the experiments are presented in Tab. 1. Each column represents different gesture and the rows contain respective recognition accuracies as percentages. The numbers on the main diagonal of the table show correct identification of the gesture, others show the recognition error.

Results are summarized in Tab. 2.

On the basis of these observations, authors conclude that for the given problem of classification of gestures the best results are obtained using the SVM classifier. SVM gave the best results in the shortest possible time and was characterized by a low diversity of the results achieved in subsequent repetitions of the test.

CONCLUSIONS

The gesture recognition can be achieved for insertion into the CAVE3D system using a Kinect device and method described in this paper. Gestures can be successfully recognized using classifiers. Selection of the appropriate classifier to solve the problem of gestures recognition is very crucial. Based on studies presented in this paper it can be concluded that the decision should fall on the SVM classifier. It should be emphasized however, that the results could be slightly different for a different set of gestures or other selected classifiers parameters, but taking into account the specific nature of the problem and carefully conducted study by authors, the result of them can be considered as representative for a given research problem.

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MATERIAL, INFORMATION AND FORMATION IN PARAMETRIC DESIGN EXPERIMENTS IN THE RESEARCH LABORATORY OF THE STUDENTS OF THE FACULTY OF ARCHITECTURE OF POZNAN UNIVERSITY OF TECHNOLOGY

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Abstract
Several experiments combining analog design with digital parametric design have been presented, where the relationship between material properties and the designed shape of an architectural element play an important role. This approach allows to create digital material formations or to structure freeform surfaces, control their tectonics, through parametric modulation. Similar research tasks were initiated in the years 2003-2004 during the classes conducted at the Architectural Associations School of Architecture in London. In Poland, for the first time, making use of that experience, a number of similar teaching experiments were carried out in 2013 under the academic supervision of Krystyna Januszkiewicz and Mateusz Zwierzycki, at the newly established Research Laboratory of the students of the Faculty of Architecture of Poznan University of Technology.

Keywords: Digital Tools; parametric design; analog design; material; performance; information; formation; experimentation

Digital design tools carry an enormous potential, which could integrate architecture and building technology, assign a new form of expression, high quality and precision to architecture, by efficient and economic structures. Traditional search for a form is being replaced by a digital "formation", which must be associated with the term "information", as well as the response of a form to the environmental conditions and the characteristics of a material. Today, it is known as *performance*, which relates both to the material and its structural effort, depending on the shape of the form[1].

When architecture is informed by the results of performative analyses, then it ceases to be a form as such – it is considered as a material formation. Therefore, the essence of such a design lies in the rules governing relationships and the model illustrating structural and material relations. Digital models obtained in this way are structural models, in which the relationship between material parts and the whole form can be modulated parametrically. This is a completely new approach, especially in the aspect of solving tectonic and structural problems, in relation to design of free forms of complex geometry.

Experiments with multiple parameters, with a wide variety of formative forces acting at the same time, are almost a new venture - especially when it comes to assessing diversified criteria including spatial, structural and material characteristics, as well as properties resulting from the use. Such research tasks were initiated in the years 2003-2004 during the classes conducted at the Architectural Associations School of Architecture in London[2]. In Poland, for the first time, making use of that ex-

[1] see: Branko Kolarevic, Ali M. Malkawi, *Performative Architecture: Beyond Instrumentality*, Routledge, 2005.

perience, a number of similar teaching experiments were carried out under the academic supervision of Krystyna Januszkiewicz and Mateusz Zwierzycki, at the newly established Students' Research Laboratory at the Faculty of Architecture of Poznan University of Technology[3].

1. TASK DESCRIPTION

The task was to design a self-supporting wall, the purpose of which might be modulation of climate in architectural or garden interiors, separating usable space in order to provide shade and privacy, or as a free-standing decorative element. A free choice with regard to material and shape was allowed, encouraging the selection of materials which are easy in modeling, affordable and widely available. The task was focused more on the research process itself, its methodology, rather than on a search for a technologically advanced building material. The idea was to study a relationship between the geometric characteristics of a shape and physical characteristics of a material, and to prepare their parametric record to generate a digital geometric model, which in the CAD/CAM system is necessary for the formation (fabrication) using CNC robots.

2. TEST PROCEDURE

The first stage of the research included learning about the method of freeform surface modeling using NURBS-based tools. Experiments consisted in spreading digital surface on the profiles in search of the most convenient shape, i.e such that its spatial configuration ensures stability to the wall. Such surfaces were modeled, whose arrangement of the folds and the center of gravity would ensure the maintenance of balance without placing unnecessary supports. Mostly freeform surfaces with complex geometry were obtained.

During the second phase of the research, works were carried out aiming at dividing the digital surface into its constituent parts. At the same time, physical properties of the selected material were examined in terms of bending, cutting, and assembly, as well as its aesthetic values were evaluated. Draft physical models of the project sequence were built by hand. At this stage of the research, the methods of tessellation and contouring of curved surfaces were learned in order to divide them into flat elements, as well as the dynamic relaxation method as a way to optimize a system of similar elements, the method to boost their spatial self-organization.

Each time a protocol with records of the properties was drawn, and the obtained numerical parameters were published in the research logbook, together with the photographic documentation. In some cases, the studies proved that the properties of the material did not allow for a selected shape of the wall. Then, a modification was required, and even a change of the material. The aesthetic values could also be an obstacle. There is a correlation between the shape and the material, which means that there are shapes that in one material look better, and worse in others. The same goes for colors. While selecting a different material, we already bear in mind its desired properties.

In the third phase, when the results were already satisfactory and the protocols comprised all the necessary information and parameters, experimenting began with translating these data into a record that a computer could understand. Rhino Grasshopper application proved to be helpful here, created for parametric design. It allows for easy preparation of the script and creating individual boxes and connecting wires. Using this application, it was possible to generate 3D models needed for the design representation and for the creation of a prototype and of the final product.

It should be noted that the result of the shape and material analyses are digital models, which are structural models, where the relationship of the material parts with the whole form can be modulated parametrically.

2.1. Knots and weaves

Interest in woven structures, although having a long tradition in building and primitive art, it became enforced in architecture only thanks to Gottfried Semper (1803-1879) and Kenneth Frampton (born in 1930). They turned attention more to their structural aspect than just a source of decorative motifs. In the era of digital technology, woven structures entered the computer space as one of the ways of structuring the surface of a complex geometry.

The research work *U Knit* covers the study of a shape and structure of the free surface in response to possibilities of forming a corrugated PVC tube (cable protector). The study focused here on finding a weave that would provide the desired stability and aesthet-

² see: Michael Hensel, Achim Menges, *Material and Digital Design Synthesis*, AD, Vol. 76, No. 2, 2006, pp. 82-86 also: Michael Hensel, Achim Menges, *Morpho-ecologies*, AA Publications, London, 2006.

³ For a more detailed description of these experiments see: Adam M. Szymski, *Free surface and material. Parametric design at the Students' Research Laboratory at the Faculty of Architecture of Poznan University of Technology*, AV 3/2013, pp. 52-57 and AV 4/2013 pp. 52-56.

ic quality. Different types of knots and weaves were analyzed, found in knitted fabrics made by hand and by knitting machines. A physical research model was created, which allowed for an assessment and conclusions. As a result, own kind of knotted weave was developed, which met the expectations of the designers. The collected parameters allowed for the preparation of a digital geometric model using Rhino Grasshopper application. It turned out that the *U Knit* fabric made of PVC tube is so rigid and flexible at the same time, that it can be used in the formation of multipurpose corrugated surfaces. The recycled material can also be used, ensuring its repeated use. Thanks to its resistance to adverse weather conditions, it may also be located outside the facility, be a functional element, or just a decorative, masking, separating or protective one. It can also be manufactured as a customized product (*mass customization*) in accordance with the demands of the customer.

2.2. Grids – Net Wall

Can a simple garden grid made of plastic, with rigid knots, be a building block for a surface of a complex geometry? One of the research teams sought for the answer to this question. In a step-by-step study of the material and shape, the focus was on the issues of translucency of the proposed wall, depending on the number of overlapping layers of a grid. Having determined the boundary conditions when bending the material, corrugation of the grid began. The intention was to prepare a wall from one piece of the material. First, studies of the form were performed on pieces of cardboard, to draw up a protocol of the process therefrom, which was used to write an appropriate algorithm. Based on the collected parameters on the shape and material, first, 3D geometric model was generated using Rhino Grasshopper application, visualizations were drawn up in the Rhino program, taking into account the color of the material and its texture. The result was a self-supporting corrugated wall with a continuous surface, consisting of two layers of the garden grid, which may be made of a single piece of material. Due to its aesthetic values and the material used, the best environment for this type of form would be natural parkland and recreational facilities.

2.3. Tetrahedron Wall

Regular tetrahedron is composed of four congruent (the same) equilateral triangles. At each vertex, three equilateral triangles (3 edges) meet, which is written as (3,3,3). Tetrahedron has four vertices, six edges and four walls – it is the smallest and the most stable structural element which is easy in the topological notation. It is the tetrahedron, which is supposed to embody the principles of building, which Buckminster Fuller (1895-1983) found in Nature. Fuller's topological geometry based on the tetrahedron revolutionized the engineering thinking in the mid-twentieth century[4]. It broke the Cartesian-Newtonian view, which assumed that there were primary structures as well as the forces and mechanisms that caused their interaction. He proved that every structure should be understood as a manifestation of its relevant processes. These processes form a network of relationships that are dynamic by nature. How, then, to use the tetrahedron as a tectonic element structuring free surface?

The research work *Tetrahedron Wall* comprises a study of the shape and material for a free surface, in response to the possibilities of forming aluminum sheet of the thickness of 0.3 mm, used in the printing industry. Based on the regular tetrahedron, the study focused on finding spatial elements, which as constituents would provide the desired shape and stability, as well as aesthetic quality to the proposed wall. First, properties of the material were analyzed, its rigidity, crush resistance and aesthetic values of the surface. Then, the behavior of small metal strips was studied (corrugation, bending, folding) and the results were mapped in the language of geometry. A method of combining tetrahedral elements was sought, so that the performance of the structure corresponded to the characteristics of the shape of the previously modeled free surface. Also, a physical model of certain sequences of the design was made, which allowed for the evaluation and conclusions. As a result, an overlapping method of combining tetrahedrons was developed, which enabled the mapping of the shape of the modeled surface.

Collected parameters regarding the geometry made it possible to draw up a digital model using Rhino Grasshopper application. The resultant parametric model provided the dimensions needed to create the prototype, which is cutting out and assembling a certain number of tetrahedrons, diverse in terms of size, and arranging them in the correct order.

It turned out that the structure called *Tetrahedron Wall* made of a 0.3 mm thick sheet is sufficiently rigid and flexible at the same time, so that it can be used in the formation of the corrugated multipurpose surfaces. The recycled material can also be used, ensuring its repeated use. Thanks to its resistance to adverse weather conditions, the corrugated wall may

[4] see: Buckminster Fuller, E. J. Applewhite, *Synergetics: Explorations in the Geometry of Thinking*, Macmillan, New York, 1975 and Buckminster Fuller, E. J. Applewhite *Synergetics2: Explorations in the Geometry of Thinking*, Macmillan, New York, 1979.

also be located outside, as an element separating the space and used for microclimate modulation.

3. TENSEGRITY WALL

Tensegrity (tension and integrity) structures are meant to be the spatial systems, in which the mutual stabilization of the elements under tension and compression occurs. Spatial systems then consist of rigid components (typically rods, but also the three-dimensional elements) interconnected by means of flabby elements (taut ropes, thin rods, etc.). Rigid elements can not come into contact. The invention of such a design system is attributed to B. Fuller (1895-1983) and K. Snelson (born in 1927), who in the first half of the twentieth century experimented with spatial interaction of forces in building construction[5].

While building such a system, one of the research groups reached for simple translucent film for their wall to become an optical barrier. In a step-by-step study of the material and shape, the focus was on the issues of translucency of the designed wall, depending on the number of overlapping layers of film. Initially, the wall was to be built of "pillows" filled with water of various colors, but welding of the film and maintaining the stability of the wall turned out to be a problem. Apparently, the simplest idea would be to design a wall from one piece of the material. To improve its rigidity, experiments were carried out with wooden slats of a small cross section. Therefrom the idea was born of using the tensegrity system as a structural backbone on which material having a low coefficient of rigidity could be stretched. Having adopted such a way of thinking, first a physical model of the tensegrity module was developed, the variable size of which would allow to obtain the desired shape of the previously modeled free surface. Wooden bars and a plain string were used. Based on the collected parameters regarding the shape and material, as well as the record of the activities, a 3D geometric model was generated using Rhino Grasshopper application. The visualization was prepared in the Rhinoceros program, taking into account the color of the material and its texture. The result was a self-supporting corrugated wall of continuous surface, made up of spatial modules of different sizes covered with this film. Due to its aesthetic values and the material used, the best environment for this type of form would be natural parkland and recreational facilities.

CONCLUSIONS

By combining digital and analog design methods, a new approach to architectural design was developed. It is based on the study results of a material in terms of its formation possibilities. These results, translated into the language of geometry, introduced into the Rhino Grasshopper program, allowed to prepare digital material formations. 3D digital models were obtained, which were structural models at the same time. These are models in which the relationship between the material part and the whole form can be modulated parametrically. During the design and research experiments, a certain confrontation took place between the current "analog" design experiments (students) and the reality of modern computer tools in the formation of spatial structures. After all, attempts for tectonic considerations in the architectural design to become independent of the digital techniques is not a new concept in architecture.

However, the currently present extension of the CAD/CAM capabilities in modeling, fabrication and object implementation, resulted in focusing attention to those structural aspects of the design, which should translate into the form already at the beginning of the design process. This forces an architect, a builder and a contractor to come closer at the initial stage of the project. At the same time, it implies changes in architectural education and a need to improve the design tools.

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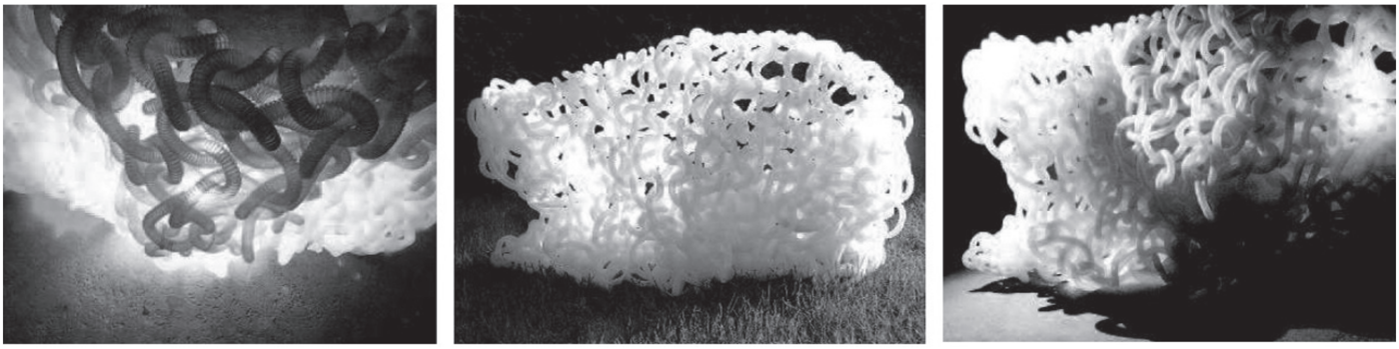

Fig.1. M. Korzec, D. Piechocińska, Sz. Nowakowski, *Knots*, 2013
Course Liders: Krystyna Januszkiewicz, Mateusz Zwierzycki, Faculty of Architecture (Research Laboratory of Parametric Design), Poznan University of Technology, Poland

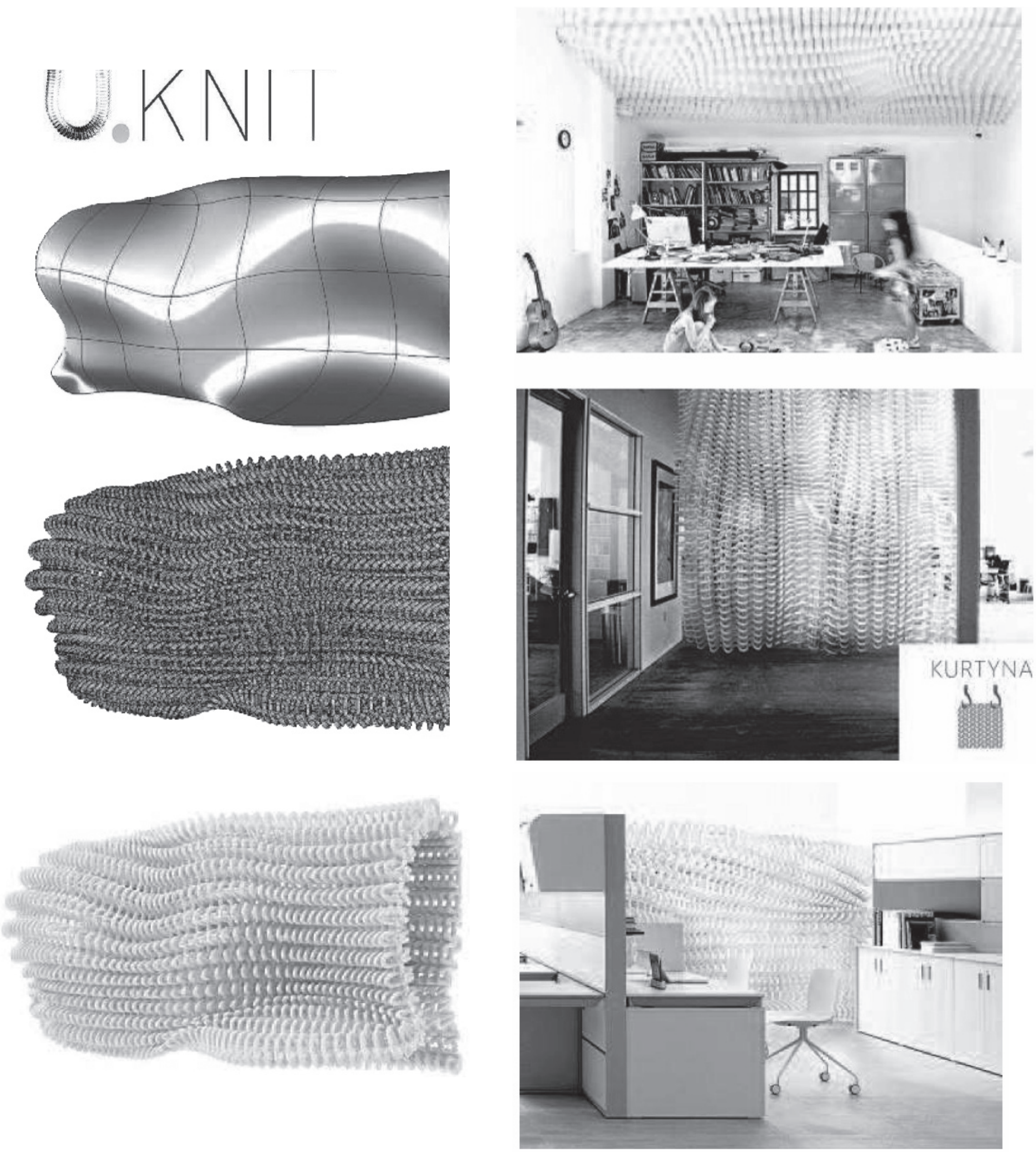

Fig. 2. M. Korzec, D. Piechocińska, Sz. Nowakowski, *Knots*, 2013
Course Liders: Krystyna Januszkiewicz, Mateusz Zwierzycki, Faculty of Architecture (Research Laboratory of Parametric Design), Poznan University of Technology, Poland

THE ACT OF DESIGN – BEYOND THE DIGITAL?

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Abstract
The aim of this paper is to discuss a very initial stage of architectural design. To achieve that, the way architects work at the early phase of design task is taken into consideration. For the purpose of analysing the process, two groups of designers are distinguished, viz.: novice and familiar with digital media. A few experiments are described in order to reveal a process of creative thinking and, what is more, to point out a hybrid analogue-digital environment as a preferred setting to study and deal with a design problem. However, it is difficult to assign the act of creation itself to certain rules and methodologies since it seems to exist somewhere beyond – elusive and unpredictable.

Keywords: design methodology; digital - analogue cognitive thinking; hybrid design environment

INTRODUCTION

The subject of an early stage of design process has been present in numerous publications for decades. Such organisations and conferences as eCAADe, ACADIA, CAADRIA, SIGRADI and CAAD Futures have become the best forum of sharing knowledge and experience in this field. One of the main areas has been focused on discussion the role of emerging technology and various digital media in architectural practice. As a result, the concept of Direct Design in virtual space was presented at the eCAADe Conference in 2002 as an opponent to two-dimensional and not interactive working environment (Asanowicz, 2002).

According to some researchers, nowadays a distinction between real and digital has become pointless since information and communication technology has embedded in the physical world and sunk into it deeply (Brown, Winchester, Knight, 2008). This process is observed in everyday life where development of multimedia influences the perception methods of contemporary generations, who absorb knowledge in a different way than their predecessors. The question is if architectural design sphere has fully settled in the ubiquitous computing world.

Actually, architects to explain issues related to a project, use more than one medium - they take a piece of paper and a pencil, and then, if it is at presence of a client, they sketch and talk simultaneously. It is somehow their natural manner of communicating a design concept. By doing that they intensify the feeling of catching the problem and getting to a clue, to a concept.

Comparing traditional versus virtual or real versus digital might lead us to unexpected discovery that forms created in virtual space are much more realistic than those shaped with the use of traditional tools. The reason for that is the latter is more abstract in nature. According to Asanowicz: “(…) currently, we often meet the opinion that the project completed using traditional tools is much more virtual than the project completed in virtual space. Nowadays, the Virtual is much more Real than the old Real ever was. Traditional drawings present the ideas that arise in our mind, in a very simplified form. It shows only a very approximate appearance of a future object. The forms created in virtual space are much more realistic than the traditional reality. We create and at the same time we see the result of our creative actions” (Asanowicz, 2012).

1. THE ACT OF DESIGN – THE CREATIVITY PHENOMENA

A very early stage of creation, when the idea is not "there" yet, seems to be elusive and unpredictable, since it is impossible to estimate time required and result achieved. As a result, a question emerges what tools and media may occur helpful to find, express and transform that idea. Referring to Asanowicz: "The design process is an expression of abstract ideas through images and its transformation in a design of the building. Designing is considered a multilevel activity in which there is no universal tool to solve all design problems. Therefore an environment in which communication between various design tools will be possible is needed. It is necessary to create such conditions of work where the possibilities of the chosen tool will not limit the creative potential of the architect. Working space should allow drawing, writing, modeling and searching for information in a natural and intuitive way. Intuitiveness of work in the new space is extremely important as it allows the designer to concentrate on design problems, instead of on how to use the tool. On the other hand, tools should provide maximum flexibility, due to the lack of determined rules and indefiniteness of the early stages of design" (Asanowicz, 2012).

For the purpose of analysing the characteristics of an early stage of a design process, two groups of designers have been distinguished, viz.: novice and familiar with digital media.

2. THE FIRST DESIGN STUDIO

Present-day students belong to a generation born in Internet era, so they are used to personal computers and various PDA devices enabling them to stay on-line and be informed constantly. However, it is observed computer literacy - in terms of using software as a design tool - is not so obvious. It is particularly noticeable in architectural domain since generally first year students are not familiar with computer aided design tools. In consequence, they are to make their first projects and presentations of concepts before they are acquainted with digital tools. Candidates for studying architecture are expected to be manually talented, not computer biased. So, their first design experience is analogue based and, what is more, they are getting used to designing with a support of traditional techniques. They focus on the task and they involve already possessed and tested skills since such techniques seem natural and suitable for expression of ideas and, additionally, do not limit a creator who suffers lack of CAD proficiency. They basically comprise of drawing with a pencil, pen or crayons, cutting and trimming with scissors, gluing and even building very simple mock-ups, resembling the exciting experience from the childhood (ready toolkits for kids, for example castles, airplanes, doll houses etc).

Not only a novice student but also an architect may feel uncomfortable while he/she is expected to find an idea and visualise it having just digital tools on his/her disposal. The creative process is limited or even blocked when necessary skills are missing. That is why such phenomena as dichotomy, dualism or hybridisation are associated with an early phase of design.

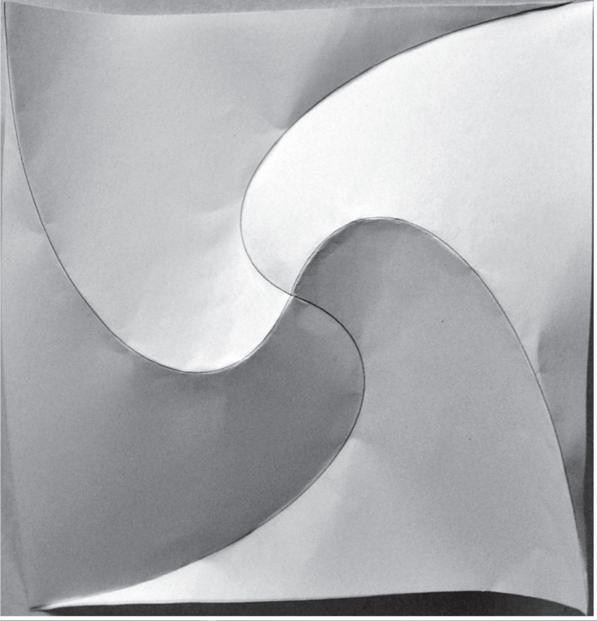
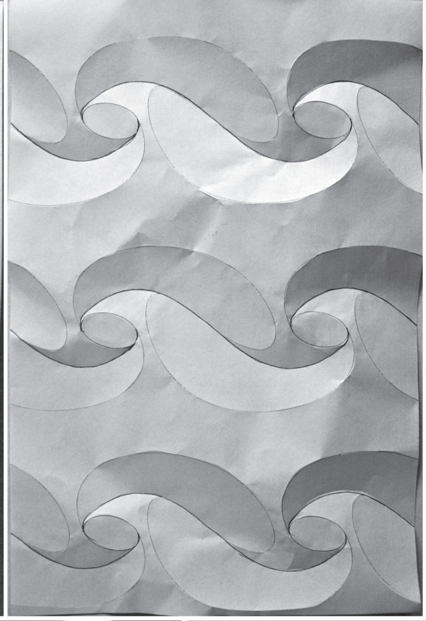
3. NOT A NOVICE DESIGNER

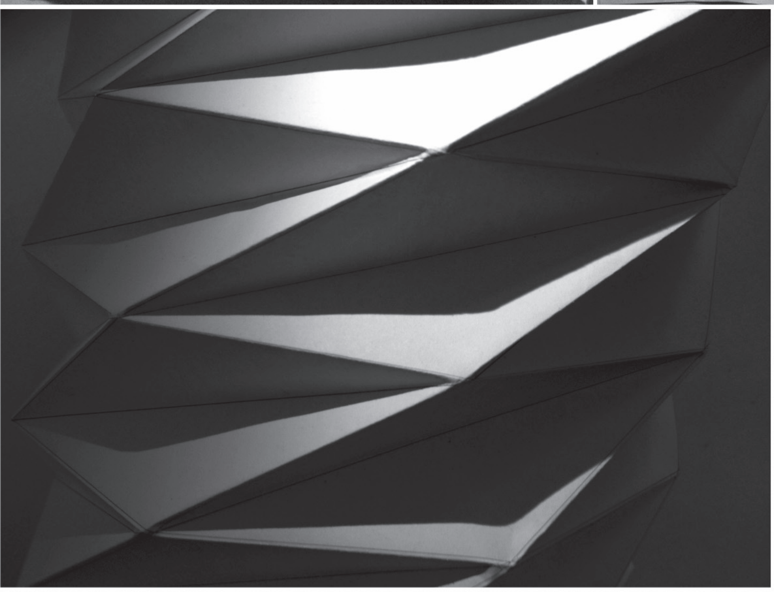
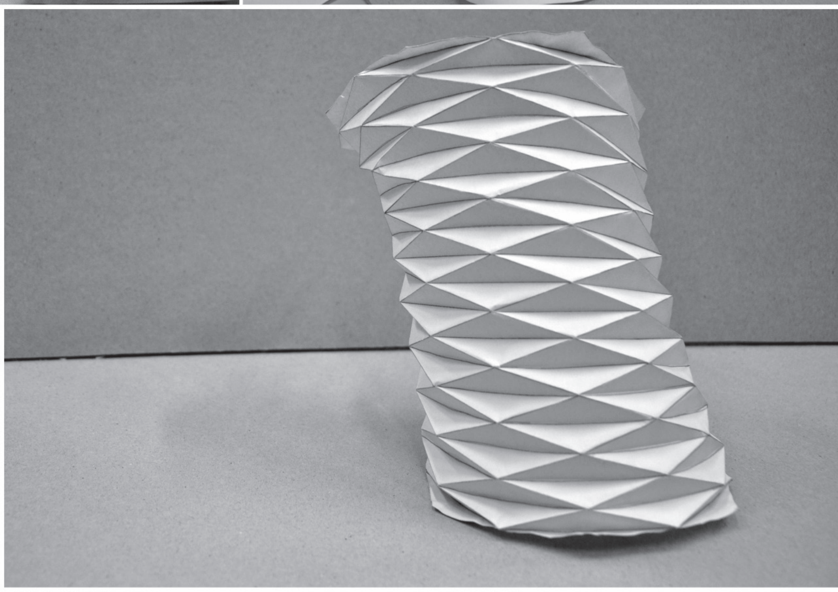
The second group taken into consideration is presented by students who have already been introduced to computer aided design tools. It allows for making some observations and comparisons.

So, it is clear that digital techniques have not replaced traditional tools so far and, it may be assumed they will never do. What is more, the latter methods appear more natural and in tune with human mind. They allow for immediate recording of first ideas, blurred impressions and imprecise forms. Even if it is a momentum only, nothing more than a sketch, a few lines before the idea is transformed into digital environment, this act of catching and registering an idea remains analogue. It leads to a conclusion that there is a strong relation between mind and a hand - stronger than between mind and a computer.

It is worth noting that students who start a design task by opening a certain program need much more time to come up with an idea, since they are limited not only by their imagination but also by chosen software capabilities. They are less effective and the results often resemble more a collage of ready to use software libraries than a genuine concept. It is observed that predefined working environment has an evident impact on a creative process. It may block natural dynamics of the process and a brain storm phase. Moreover, it may limit variations to fit certain rules and procedures. Instead of a holistic vision the result is poor intellectually and can not be satisfactory.

Similar situation was experienced in the early years of CAAD, when imagination was constrained by modest array of tool palettes on the one hand and insufficient computer literacy on the other hand. Digital aids to architectural design process seemed to be more an obstacle than facilitation. In consequence, they were regarded as an option and evoked negative attitudes since they were not recognised as a change of paradigm.


4. THE ACT OF DESIGN – STUDY OF A CONTEXT

There is no doubt digital tools have become crucial at the early stage of design as a background support. They are widely used for gathering information about the problem, gathering information about the site and surroundings, for spatial modeling of the place and neighbourhood, for developing various analyses in order to visualise and understand a context. A variety of devices and systems are used, for example 3D scanners, laser cutters, 3D printers, video capture.

To sum up, the registration of collected information is mostly arranged in digital format and, what is more, from digital (Internet) sources. However, despite such careful and precise preparation of background conditions the question how to support creative thinking with digital tools needs further investigation.

5. CASE STUDIES

A few experiments have been chosen in order to reveal a problem of creative thinking while designing in hybrid environment.

The first example deals with a question of a digital form generated by a computer versus physical imagination boundaries of a designer. To explain the problem I chose examples of two workshops on algorithmic design techniques (Kepczynska-Walczak, 2008). Students tried to write a proper script in order to achieve a spatial form in a controlled way. It was observed the visual solutions depended mainly on cognition of algorithmic design and programming skills. Though, not in every case computing skills followed imagination and, in consequence, some students were not successful. Moreover, another problem of designer's imagination limits was revealed: visualisation of transformation of figures. It is possible to obtain the final shape with the support of appropriate software but is it possible to imagine it before the results appear on the screen?

The second example is opposite to the first one since this time a workshop intended to explore students imagination by playing with a sheet of paper. Participants started with folding it to understand how valleys and mountains influence the originally flat geometry (a rectangle).

The basis of the methodology adopted was to learn by experience (Kepczynska-Walczak, 2013). According to Kolb, an experience is fundamental to learning and development. This process involves the following stages: experimentation; observation and reflection; formulation of abstract concepts and generalisations; and then applying gained knowledge and skills in new conditions (Kolb, 1984).

The exercise strongly based on geometry logics and spatial imagination capabilities of participants. No computing - only manual elaboration as the first phase of finding an idea. It was very interesting to observe the process of testing the features of paper to invent a new spatial form. Even though the group participating in the workshop was not novice to design tasks and computer techniques, the theme and methodology of the workshop appeared very novel to them. To find an idea students not only tested the natural behaviour of folded paper, but, what is more, they studied examples as a basis for their inspirations. Then, students were encouraged to use Rhino and Grasshopper to elaborate on new patterns (Figure 1). The results were expected in two days, so apparently the task turned out not to be easy since creative thinking is not linear and it is not possible to predict how much time it will consume to find a satisfactory answer to design task.

SUMMARY AND CONCLUSIONS

The main thesis of 2014 International eCAADe Workshop is that designing proceeds "somewhere in between". It means the space where manual, digital, virtual are mixing, overlapping, and transforming one into the other. While exploring the early creative stages of a design process a vague question is posed: "In what way do we design, what tools/means/medium do we use?"

According to Cheng : "Design requires a balance between free play and discipline (…) Familiarity with a wide range of techniques gives designers the agility to integrate appropriate approaches for each phase of new situations. as each project will require a different set of tools." Cheng analysed a hybrid design approach and how physical and digital processes can inform each other in a multivalent design cycle: "In ap-

Fig. 1: Examples of students work and a final model; authors (from left top, to right down): Workshop led by: Suryansh Chandra - Senior Designer ZAHA HADID Architects, Anetta Kępczyńska-Walczak, PhD - Head of CAD Unit Lodz University of Technology, Sebastian Białkowski, MSc - doctoral student;
Students, workshop participants:I. Barańska, M. Kilańczyk, P. Krych, M. Muszalak, J. Pabian, K. Pasternak, P. Pastuszka, M. Piechowiak, K. Pytel, N. Rimsky, K. Rutkowska, D. Sokołowski, K. Stawicki, M. Sybilski, M. Trąbski, J. Wojciechowska, E. Wojciechowski, S. Zieliński

proaching a design problem, it is important to find efficient and effective tools for each stage of the project. Each tool that reveals specific perspectives and stimulates different creative opportunities" (Cheng, 2012) .

It is not surprising then that the issue of integrating virtual worlds into design teaching is widely discussed. Some authors propose strategies for integrating virtual worlds into architectural education as a contribution towards the revitalization of the architectural design curriculum (Pak, Newton, Verbeke, 2012).

There is no doubt a relationship between a designer and a digital tool has been changing. However, if there is no direct link between a designer's mind and designing tool, a designer becomes rather a reviewer than a creator. This conclusion resembles the thought of Aart Bijl, who considered the ease of use as a single most important criterion of judging the importance of new developments in digital technology. More than three decades later the question can be asked again: "Know your technology or can computers understand designers?" (Bijl, 1983).

To conclude: are we ready for Direct Design? Is virtual design space flexible enough and seamless in use to become a platform not only for representation of ideas but, primarily, for creative process?

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COMPUTATIONAL MECHANISMS IN ARCHITECTURAL ADAPTATION AND INTERACTION PROCESS THROUGH HUMAN BEHAVIOR PHYSICAL INPUTS

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Abstract
This paper demonstrates and discusses an ongoing teaching and research investigation concentrated on the development of computational mechanisms in the early conceptual design stage as part of architectural adaptation and interaction process. In order to achieve this, computational design strategies are developed involving human behavior physical conditions, which result real time design possibilities to emerge. Analytically, physical data derived from external human behavior influences are encoded and used as the input parameters in our suggested adaptation process. Together with digital or physical adaptive architectural outcomes, control mechanisms are suggested that represent the intelligence of each computational design system. The suggested process is considered as a feedback loop mechanism that cyclically iterates between design generation to perception and evaluation of design solutions according to architect-user personal decision and choice. In this paper, selected teaching and research outcomes are demonstrated and discussed, specifically in terms of their ability to produce desirable results based on the interactivity between digital mechanisms and processes as well as human behavior as physical inputs.

Keywords: computational mechanisms; adaptation; interaction; human behavior; physical inputs

1 INTRODUCTION

The rapid development of computational mechanism in architectural design opens up new possibilities in digital design process. This expands digital tools' ability to be used in architectural design beyond simple representation of forms in the final stage of design, focusing their attention on the early conceptual design development.

The tendency towards computational design investigation introduced in the second-half of twentieth century has been related with the notions of adaptation and interaction. Based on the ideas derived from biological and scientific principles, architects, researchers and theorists introduced and discussed innovative architectural design solutions generated and investigated using mathematical and computational means. Pioneer work by Alexander (1964) discussed in theoretical level the concept of gradual adaptation that produces 'well fitting' results, developing models that investigate functional requirements and their interactivity (Alexander, 1964). Similarly, Negroponte (1973; 1976) discussed adaptable machines in design (Negroponte, 1976) and intelligent buildings that response to environmental influences (Negroponte, 1973). Influenced by similar concepts, Frazer (1995) investigated evolutionary and adaptive architecture by integrating computational methods based on natural principles (Frazer, 1995) involving ideas found in cybernetics through feedback loop, an influential component in adaption process (Frazer, 1993; 1995).

The current tendency towards the investigation of digital design possibilities in the early conceptual design stage is gaining significant ground. Several directions of investigation can be found including works concentrated on the development of software and computational techniques, aiming on the digital optimization and physical transformation of buildings, spaces, etc. In all cases, adaptation and interaction is considered notable aspect of digital or physical architectural solutions. In order to achieve this, new tools focus on the incorporation of different parameters and data inputs with the parallel use of control mechanisms as medium for the production of adaptive and interactive outcomes.

In one direction, parametric-associative design logic is used as the control mechanism towards design generation, modeling and simulation. In another direction, physical systems transform their behavior through kinetic principles and embedded technology. The use of kinetic mechanisms and materials on the one hand, and sensors, microcontrollers and actuators on the other hand shows the multidisciplinary direction of current design investigation in order to achieve physical real time behavior of prototypes (Fox and Kempt, 2009; Achten, 2011).

In all cases, architectural adaptation and interaction might be seem as the output results of the process where environmental, human related or other internal and external conditions are functioning as the input part of the control mechanism. The incorporation of human behavior as physical input into the control mechanism of digital design is gaining considerable attention. This can be achieved using sensors and other devices like Kinect camera, allowing the transformation of physical information into the mechanism for digital design development (Lücker et al, 2013).

This paper attempts to investigate adaptation and interaction in the early conceptual design stage based on a proposed feedback loop procedure where cyclical iterations between design creation and verification of results and the parallel use of human behavior physical inputs are used to find solutions that satisfy architect-users personal criteria. Hence, discussion in regard to the process of adaptation as computational mechanism involved in design and its correlation with decision-making process is under consideration.

2. COMPUTATIONAL MECHANISM AND FEEDBACK LOOP PROCESS

Based on previous work done by the author (Kontovourkis, 2013), this paper demonstrates an updated version of our suggested feedback loop design framework that explains adaption and interaction as part of digital design process. In parallel, the way computational mechanisms are applied towards the development of physical/digital results is explained.

In the diagram of [Fig. 1.] three main areas are distinguished: input, output and control mechanism. The human behavior physical conditions are included in the input area represented as the internal input together with the external environmental related input data. The adaptive physical/digital output results are included in the output area, and finally the adaptive or interactive behavior of the system is included in the control mechanism area.

Analytically, sensors, Kinect camera or other devices are used for the acquisition of human behavior physical input data, which are encoded according to the simulation tasks, different in each case. Output results continuously influence and update the input data leading to the production of adaptive or interactive design results. In parallel, other input data, in this case external, are used in the feedback loop process feeding the systems independently. These can be incorporated into the system influencing also the output results. Through actuator mechanisms that control the

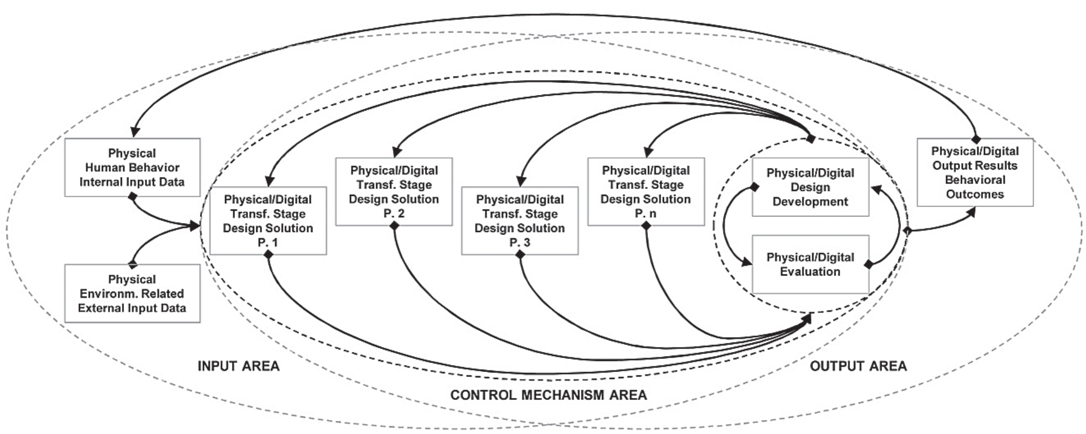

Fig. 1: Feedback loop process for architectural adaptation and interaction: drawing: by author

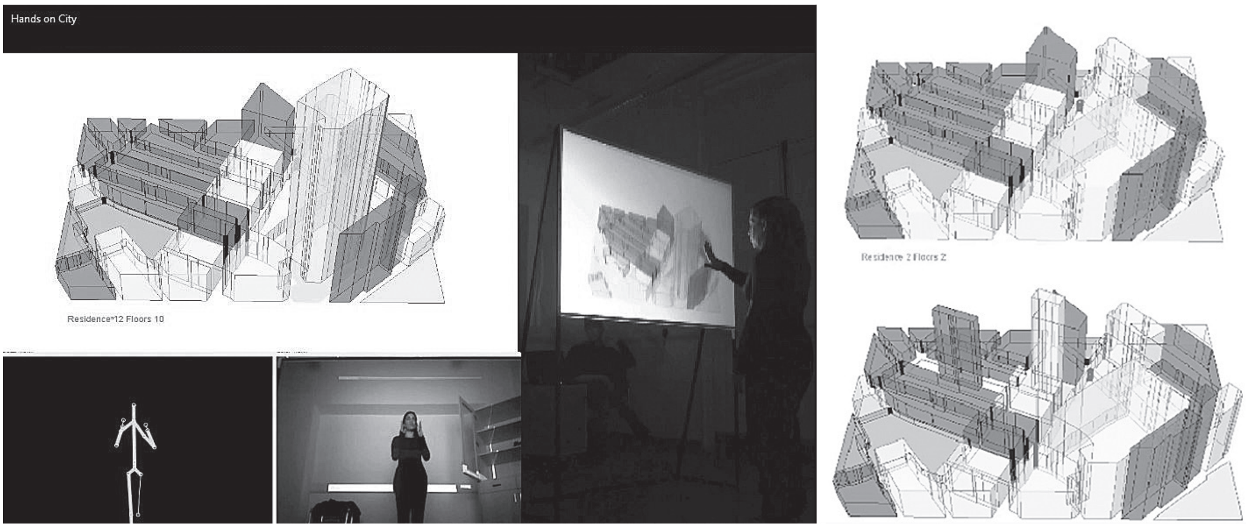

Fig. 2. Adaptation of urban fabric through hands motion behavior.
Authors: Anagiotou Despo, Kyriazis George, Papapetrou Kleopatra, Hatzicharalabous Stella, ARH-522, Fall 2012 (Kontovourkis, 2013)

behavior of kinetic systems or through projection of adaptive or interactive design outcomes in the physical environment, the perception of results by the architect-users can be achieved.

In the control mechanism area that is functioning as the intelligence of the system allowing the adaptation or interaction between human behavior inputs and output results, two main parts are suggested. The part dealing with the design development related to the 'creativity' and the part dealing with the evaluation of proposals expressed as the 'accuracy' part. 'Design development' and 'evaluation' parts are continuously iterated leading towards digital adaption and interaction or physical transformation of the proposed architectural system.

A number of outcomes are produced (1, 2, 3, n) assisting design decisions taken in the early conceptual stage. Numerous repetitions in the open loop procedure allow verification of output solutions through control mechanisms and human behaviour physical input. The decisions taken within this process are not only controlled through algorithmic rules introduced in the 'evaluation' part but also through intuitive process. The human behaviour physical conditions and the way these are encoded influence adaptation and interaction.

Following examples show different computational mechanisms that involve the application of sensors, microcontrollers and actuators. Arduino technology is used to connect the physical with the digital world and vice versa, and is associated with parametric design software Grasshopper (plug-in for Rhino) through Firefly (plug-in for Grasshopper).

3. ADAPTATION AND INTERACTION THROUGH HUMAN BEHAVIOUR PHYSICAL INPUTS

The following experiments are dealing with adaptation and interaction in the early conceptual design stage. These have been developed in the Department of Architecture at the University of Cyprus as part of the course advance topics in computer-aided design. In this course, students are asked to create from scratch their own computational mechanisms based on the suggested feedback loop framework (see previous chapter) involved in the early stage of design decision making process. In parallel, their knowledge and skills in the area of parametric design and physical computing are developed giving attention into the human behaviour physical data acquisition.

Human behaviour data are used as the real time input parameters feeding the control mechanism and in parallel achieving adaptation and interaction behaviour through algorithmic and behavioural control. Output results are developed and visualized by projecting or physical prototyping. Physical/digital transformation possibilities are produced and evaluated based on the criteria specified by the architect-user and according to human input as well as to generated outcomes.

In the project shown in [Fig. 2.], suggested computational mechanism is used to develop an adaptive and interactive relation of architect-users with the selected urban fabric. Human behaviour, in this case hands motion tracked by Kinect camera, is used as the physical data accelerating adaption and interaction with the virtual environment. The role of architect-user as the sole person responsible to take design decisions in regard to the morphological transformation of urban fabric in conceptual level is considered significant.

This project [Fig. 3.] suggests a computational mechanism involved in the human behaviour data acquisition, in this case motion behaviour using motion detectors sensors, which in turn is projected on the interior courtyard of the department. The real time interactive information related to the number and area occupation of users is triggered by their continual movement and perception in the interior of space allowing feedback relations to be developed.

In another case [Fig. 4.] interactivity in a proposed elastic structure based on human bodily movement is examined. Pressure sensors are applied on the floor of the structure accelerating actuator mechanisms (motor sensors) that are responsible for its structural transformation behaviour. Through fluctuations of physical input parameters, as a result of human behaviour, a series of morphological outcomes are generated and controlled by the architect-user.

In all cases, computational mechanisms are developed using visual programming, in this case parametric-associative design logic. Human behaviour physical input conditions are derived from the built environment, encoded and used as the parameters influencing the control mechanisms. In the process of adaptation and interaction, the feedback loop between output results and input human behaviour as well as between design and evaluation plays fundamental role in any architectural system development in the early conceptual design stage. The criteria of evaluation are specified by the architect-user who takes decisions in regard to the algorithmic rules of control as well as in regard to the architectural scenarios under investigation.

Through this investigation, skills related to the use of advanced computational principles, i.e. parametric design, physical computing, etc., are offered to the students, expanding their knowledge, understanding and awareness in regard to the use of computer technology as part of design process. Obviously, results obtained show that such methodology can be used to investigate predefined scenarios, i.e. early conceptual, since the design process presupposes a large number of parameters, criteria and decisions taken in different levels, which cannot be controlled entirely by the computer.

CONCLUSIONS

In this paper, a teaching and research investigation into the development of computational mechanisms in architectural adaptation and interaction is presented, giving emphasis on human behaviour conditions as the physical inputs that feed our proposed conceptual design framework. Based on the idea of a continuous feedback loop mechanism, design results are evaluated in real time under the influence of those physical conditions allowing large number of design possibilities to emerge. However, such tools offered limitations and potentials especially in regard to the general design process. Digital processes can only be part of design decision making process and cannot replace entirely

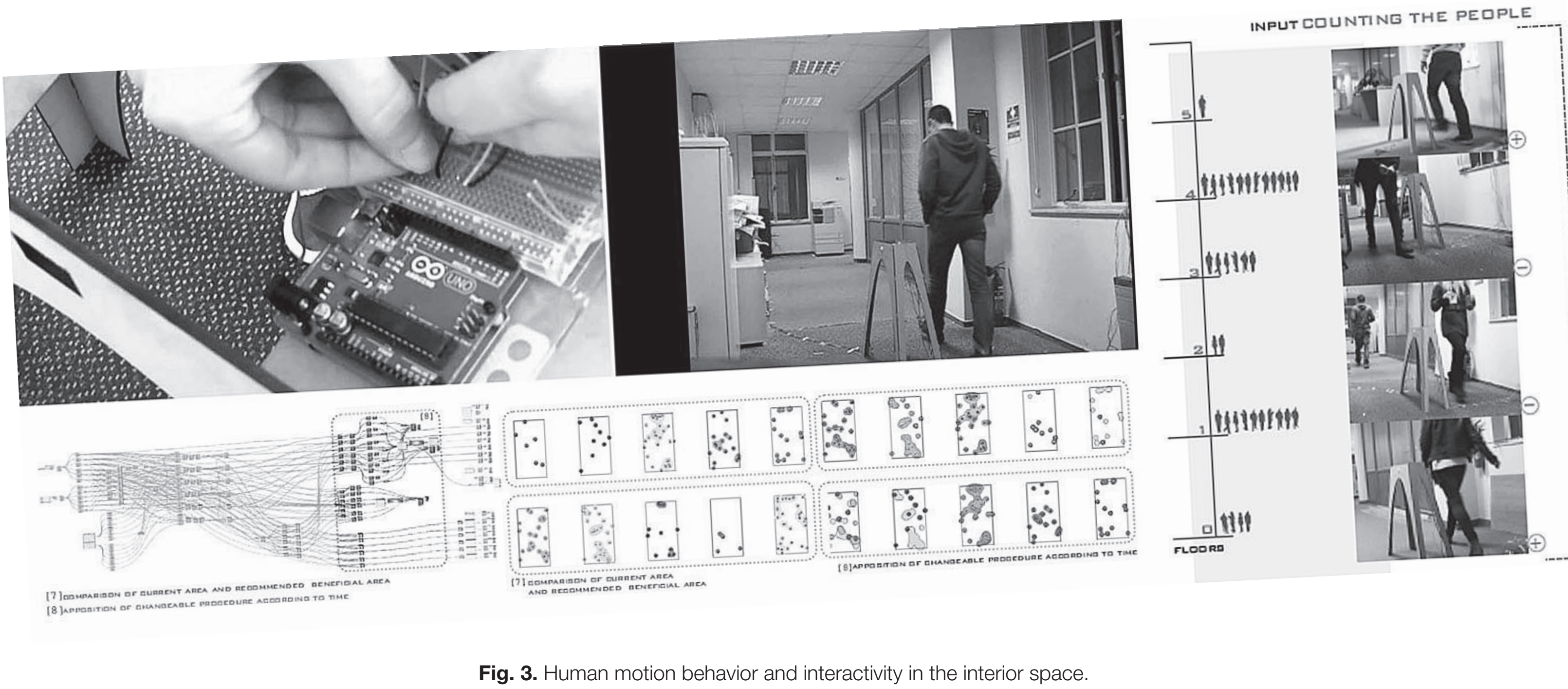

Fig. 3. Human motion behavior and interactivity in the interior space.
Author: Antoniou Melina, Konatzi Panayiota, Neofytou Ifigenia, ARH-522, Fall 2012 (Kontovourkis, 2013)

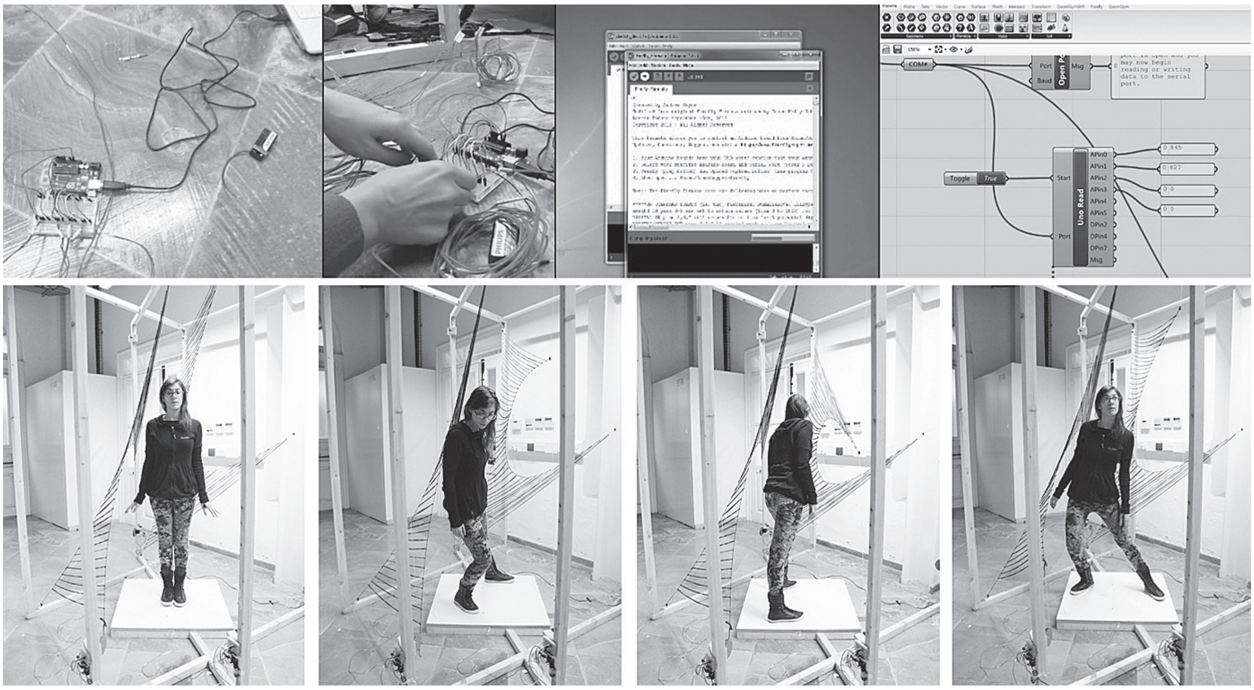

Fig. 4. Human bodily movement and adaptability of a responsive elastic structure.
Author: Georgiou Niki, Pavlou Rafaela, Pirikki Nicky, Polychronidou Pantelina, ARH-522, Fall 2013

the role of architect who is responsible to control design in different stages, an important aspect in this investigation process, which is conceived by the students raising their personal awareness in digital issues.

In conclusions, current teaching and research investigation might offer to the students as well as to the architects new knowledge and skills towards the application of digital tools in design decisions making process, especially in regard to the way new technological issues are applied in adaptive and interactive design process. In this way, developments towards an interdisciplinary research direction that use technology as the medium to connect the physical with the digital world, aiming to find close relations and links with the dynamic influences of the build environment can be achieved.

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THE VIRTUAL PROMENADE. DIDACTIC EXPERIMENTS ON THE POTENTIALS OF COMBINING CONVENTIONAL AND DIGITAL MODELLING OF THE CITY EXPERIENCED IN MOVEMENT

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On the 110th floor, a poster, sphinx like, addresses an enigmatic message to the pedestrian who is for an instant transformed into a visionary: It´s hard to be down when you´re up.[1]

Abstract
Through a 3 week workshop in March 2014 a group of third year students from The Royal Danish Academy of Fine Arts, School of Architecture will create their own imaginary city based on phenomenological experiments in Copenhagen and an interpretation of these experiences combining conventional and digital modelling. The workshop serves as an education-based research project in which we want to investigate the potentials of working consciously with bodily movement as a generator in the creation of architecture by combining actual experience of the city with conventional model building and digital modelling seen through latest Virtual Reality technologies. Thus the research question is two-folded: What kind of architecture can we imagine and conjure through movement combining classical tools and methods with newest technology and how do we respond to these new tools and integrate them in the education of future architects? This paper is therefore likewise divided. The first part is about the city and the architectural tools involved in the workshop. This section is titled Representing the City. The second part is elaborating on the technical aspects of the Virtual Reality technology used. This part is titled Applied Desktop Virtual Reality.

Keywords: Virtual Reality; Oculus Rift; stereoscopy; The Architectural Promenade; city planning; architectural representation

1. REPRESENTING THE CITY

Urban area architecture is often developed as static diagrams, projection drawings, small-scale models and fixed perspectival images in a continuous process from outside and inwards – from master plan to doorknob. This rational approach is communicable and buildable, but often distanced from the actual experience of its build reality; our life and environment is always experienced in an embodied and opaque totality - and always experienced in motion. If we want to grasp the complex relation between the rational overview and the actual sensation when creating architecture, we need a deliberate use of the means of our investigation; the different architectural tools and methods lets us understand and represent different and equally important aspects of architecture; from the urban planner´s analytical overview to the sensation and atmosphere of the local coffee shop. Movement might here serve as link between the whole and the part, which is why

[1] Michel de Certeau, *The Practice of Everyday Life.*

the launching of this experiment begins with phenomenological strolls around various neighbourhoods of Copenhagen. These walks are inspired and organized inspired by Walter Benjamin´s notion of the flâneur[2] and the writings of the situationist Guy Debord[3] who wandered the streets of Paris in the fifties.

2. THE FOUR MODES OF REPRESENTATION

After these initial exercises the workshop is based on effective and low-cost methods and tools available to students in general: conventional model making as both structure models in 1:500 / 1:1000 and as scenographic sets in 1:25 and Sketch-Up for digital modelling. In addition to this, we experiment with a prototype of VR technology which soon will be available and affordable to the general public. Working consciously with these different architectural tools, we will search for their individual potentials and particularly their possibilities as combined ways of approaching a fuller architectural understanding. Which tool serves what purpose?

The following assumptions on the various tools engaged in this workshop will be addressed, tested and challenged:

2.1. The Structure Model

The conventional structure model in e.g. 1:1000 in foam or card provides a static, analytical overview. The total of the urban fabric can be read as nodes, landmarks, openings, infrastructure, neighbourhoods etc. from a distant vantage point. Rational understanding of composition and its overall structure is possible. As the voyeur looking at Manhattan from the top of the Empire State Building - as phrased in the beginning by de Certeau – the architect can see the small-scale model from above: “It allows one to read it, to be a solar Eye, looking down like a God.”[4]

2.2. The Scenographic Set

This kind of model falls short, when dealing with the actual architectural experience; the scale distances us from its “interior”; we look down upon it and have to rely on our imagination when it comes to the actual experience and perceptive experience of the city. The detailing, life, materiality, weight etc. remains vague or unknown. These fundamental aspects of architecture seem more appropriate to approach in a bigger scale. The conventional and detailed large-scale model or scenographic sets - in e.g. 1:25 in card or wood - can provide us with good possibilities of examining architectural and sensual experience of the project. It can be made fast and altered spontaneously and is present as physical and haptic object to be touched and discussed in this world.[5]

Fig. 1. Conventional structure model, photo: by authors

Fig. 2. Scenographic sets, photo: by authors

[2] W. Benjamin, *The Arcades Project*, Harvard University Press, Cambridge 2002.
[3] G. Debord, *Theory of the Dérive,* Internationale Situationniste #2, Paris December 1958.
[4] Certeau, de M. *The Practice of Everyday Life,* University of California Press, Los Angeles 1988, p. 92.
[5] As adressed by Juhani Pallasmaa in Pallasmaa, J. *The Eyes of the Skin*, West Sussex, Wiley 2005.

2.3. The Digital Model

Then again this technique has its limitations. If we want to come close to materiality and detailing, for example, the scale and time required, makes it relevant to use when dealing with single buildings, but not sequences of spaces like a street. It is simply too big and complex to build. This is exactly the immediate strength of the digital model: It has a certain overview as the conventional structure model and the possibility of diving down into it – realizing its perspectival and spatial character. What the ordinary 3D sketch model can´t provide though, is the sense of gravity and embedded sensation of reality. It is still experienced flat on a 2D screen.

2.3. VR Technology

With Virtual Reality we can approach architecture in real eye height as a total experience with free and realistic movement within the project. This leaves the notion of the Architectural Promenade and Corbusier´s saying: "Architecture is circulation"[6] an actual possibility while designing. What digital models lack though – even experienced with VR technique, is the haptic and material presence of the bigger scenographic sets.

Hereby the circuit is closed: Each of the mentioned architectural tools has strengths and weaknesses. We want to investigate the haptic, sensational qualities of the city at all scales, and we will seek new ways to combine the conventional and digital models in an effective workflow with added value.

3. APPLIED DESKTOP VIRTUAL REALITY

The incredible sense of presence in the Virtual Reality world, with the Oculus Rift head mounted VR googles, pushes boundaries of what is perceived as real. The effect of occluding the real world around you makes the impression of you being surrounded completely by the VR environment. When you turn your head your vision doesn't reach the edge of any screen or visual device, the model is all around you, when you look up you see the sky, when you look down you see the ground and when you turn to look back you realize you are not merely a spectator but you are IN the model.

3.1. Virtual Reality Immersion

First time experience with the Oculus Rift VR setup can be very overwhelming, you feel totally immersed although the model that you are immersed in might not be very photorealistic or "real". In our initial tests with 2nd year architecture students investigating an Oculus Demo scene, all test persons reacted by expressing something like: "Wow this is amazing". The fact that you can actually see large square pixels on the screen due to low resolution seems not to distract or ruin the overall experience.

3.2. Technical Setup

The Oculus Rift is a head mounted device with a screen showing two stereoscopic images through optical lenses, connected to a computer as a second screen duplicating the primary screen. The display screen has a resolution of 1280x800 pixels shared between the two eyes. The Oculus Rift hardware includes a gyroscope, accelerometer, and magnetometer. The information from these sensors is combined through a process known as sensor fusion, to determine the orientation of the user's head in the real world, and to synchronize the user's virtual perspective in real-time.[7]

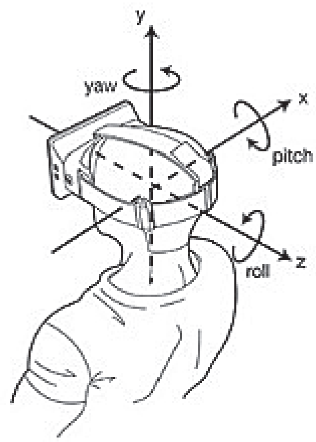

Fig. 3. The Oculus Rift, by authors
The lenses in the Rift magnify the image to provide an increased field of view, but this comes at the expense of creating a pinching distortion of the image. This radially symmetric distortion can be corrected in software by introducing a barrel distortion that cancels it out.

3.3. Depth Cues And Level Of Abstraction

In VR it is possible to realise the city's perspectival and spatial reality in real scale 1:1 constraining the eye height to match the one of the viewer. Since we measure our surroundings according to our own body and eye height we utilize one of the monocular depth

[6] Le Corbusier, *Le Corbusier Talks with Students: From the Schools of Architecture*, New York: Princeton Architectural Press, 1999, p. 47.
[7] M. Anthony M. et al., *Oculus VR, SDK Overview Version 0.2.5,* 2013.

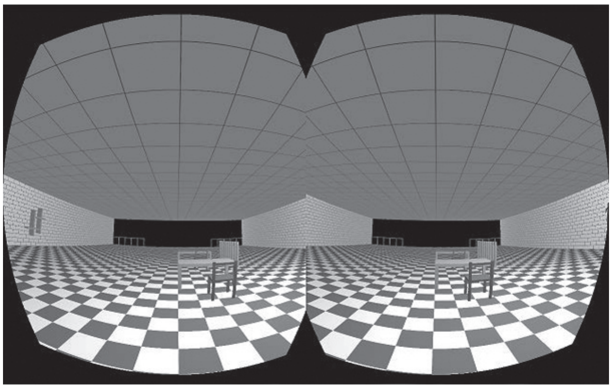

Fig. 4. Picture from WalkAbout3d, by authors
WalkAbout3d is a standalone interactive 3d content viewer capable of showing stereoscopic views and correct pinching distortion. It also works as a plug-in to SketchUp 3d modelling software. Students can investigate their preliminary 3d designs continuously, supporting an iterative design process at their studio desk in a familiar setup, since the stereoscopic features are reached from within SketchUp.

cues; familiar size. Architects are trained in reading 3d from lines only. Walking inside a 3d line drawing, a model without surface detail apart from flat shading is assumed to be sufficient for general observations. Other monocular cues like perspective, occlusion and depth from motion also provide depth information when viewing a scene in VR. Binocular cues (3 dimensional) like stereopsis provide depth information when viewing a scene with both eyes; this is simulated by two virtual cameras set up to match the viewer's interpupillary distance.

3.4. Navigation

Navigating in VR with Oculus Rift using keyboard and mouse in initial tests turned out to be quite difficult; only experienced gamers felt comfortable with this setup. A 3d-track ball (3DConnexion SpaceNavigator) proved more intuitive to gamers as well as non-gamers. Aiming at a setup as close to the daily work situation seated at a table as possible, it appeared to be a more convincing experience to be standing up while navigating thus having a physical eye height corresponding to the virtual eye height avoiding double horizon confusion. With no height adjustable tables available though, interacting with the VR environment with keyboard and mouse or 3d-trackball was not very convenient. A wireless X-box 360 game controller proved to be very user-friendly and versatile in this situation, although not a traditional tool of an architect.

3.5. Motion Sickness

The exceptional depth cues of foreground, middle ground and background are very vibrant and seem to be exaggerated in combination with the stereoscopic vision inside VR, especially when you experience looking down at something placed lower than your standing ground. When moving forward at a fast pace or looking around vigorously most students experienced some motion sickness or felt uncomfortable. By limiting the forward motion speed and ask students to only look around in slow motion these uncomfortable feelings were almost eliminated. When students got used to navigate in VR these issues seem to diminish, which indicates that you can train the ability to avoid motion sickness.

Crystal Code, the newest development version of the Oculus VR head device, features positional tracking with 3 directions of freedom and a low persistence display promising to almost eliminate motion blur and improving visual stability for a more comfortable experience.

3.6. Outcome

The workshop will provide us with an abundance of architectural visions on the city in very different modes of representation: Mapping of the existing city, collages, 3D models and physical models in various scales. Additionally we want to make a short film of the new city as a combination of 3D walk-through and model photographs. All the material will be exhibited publicly after the workshop.

Besides analysing this material and reading it as architectural consequences of the chosen methods, we want to address didactic and technical aspects of the experiment through interviews and observations in the studio: What kind of skills and knowledge do the students obtain? What technical and practical issues may have to be addressed? How can we channel possible answers into our next workshop?

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SPATIAL CONTINUITY DIAGRAM ON TIME AND DISTANCE LINE

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Abstract
The paper presents the specific method that was developed for studying existing architectural and urban structures. It has been called the Spatial Continuity Diagram. The Spatial Continuity Diagram Method can be applied for preparing guidelines which help supplementing or extending existing urban clusters while avoiding spatial or functional incongruities between existing and new buildings. Several years of improving the Spatial Continuity Diagram Method resulted in research on its implementation in the 3D spatial urban models.

Keywords: urban design; urban space; continuity

Since 2001 we have been developing our own model for studying existing architectural and urban structures. It was based on analysing the most important urban building development features. The method was developed to examine thoroughly ways of expanding and transforming existing architectural and urban structures. This method of analysing urban space has been called the Spatial Continuity Diagram. The method provides for more cautious transformation of existing buildings or erecting new ones while preserving their spatial continuity (Fig. 1).

Urban structures are studied by analysing both uniformity and similarities of buildings clusters. A mathematical formula is used to calculate the degree of uniformity of a given feature and related to it uniformity of the entire cluster of buildings. A specific matrix, which is a basis for developing an electronic inventory, is an integral part of the method. The inventory enables illustrating the distribution of particular feature categories of a cluster of buildings in a 2D space. It is very useful while providing general characteristics of the urban development and illustrating any irregularities of particular features. The Spatial Continuity Diagram Method can be applied for preparing guidelines which help supplementing or extending existing urban clusters while avoiding spatial or functional incongruities between existing and new buildings. It is particularly important that the Spatial Continuity Diagram Method examines not only existing buildings but also newly planned ones. It provides a form of a forecast highlighting the shortage or continuity of the most important features of existing buildings in new buildings that are planned. Additionally, diagrams developed through analyses enable defining the degree of continuity in planned buildings in relation to existing ones.

Despite the fact that the diagram method focused on a 3D space, guidelines formulated involved first and foremost the analysis of data and their distribution in 2D space. It was mainly due to the fact that at that time methods of creating virtual city models and their research were underdeveloped. The Spatial Continuity Diagram Method is based on collecting and processing of several thousand of data. Since the analysis involves such a large volumes of data, already from a very early stage the process necessitated computer aided calculation methods. Published in 2002, the first series of books discussed the method and had a CD with software and manual attached. The software had a form of a special Excel based application (Fig. 2a).

At the moment, the research by the Cyber Urban Centre (CUC)[1] should provide for significant widening of the research on the Spatial Continuity Diagram and including issues related to time and distance in the 3D virtual environment of urban models. Our team focuses

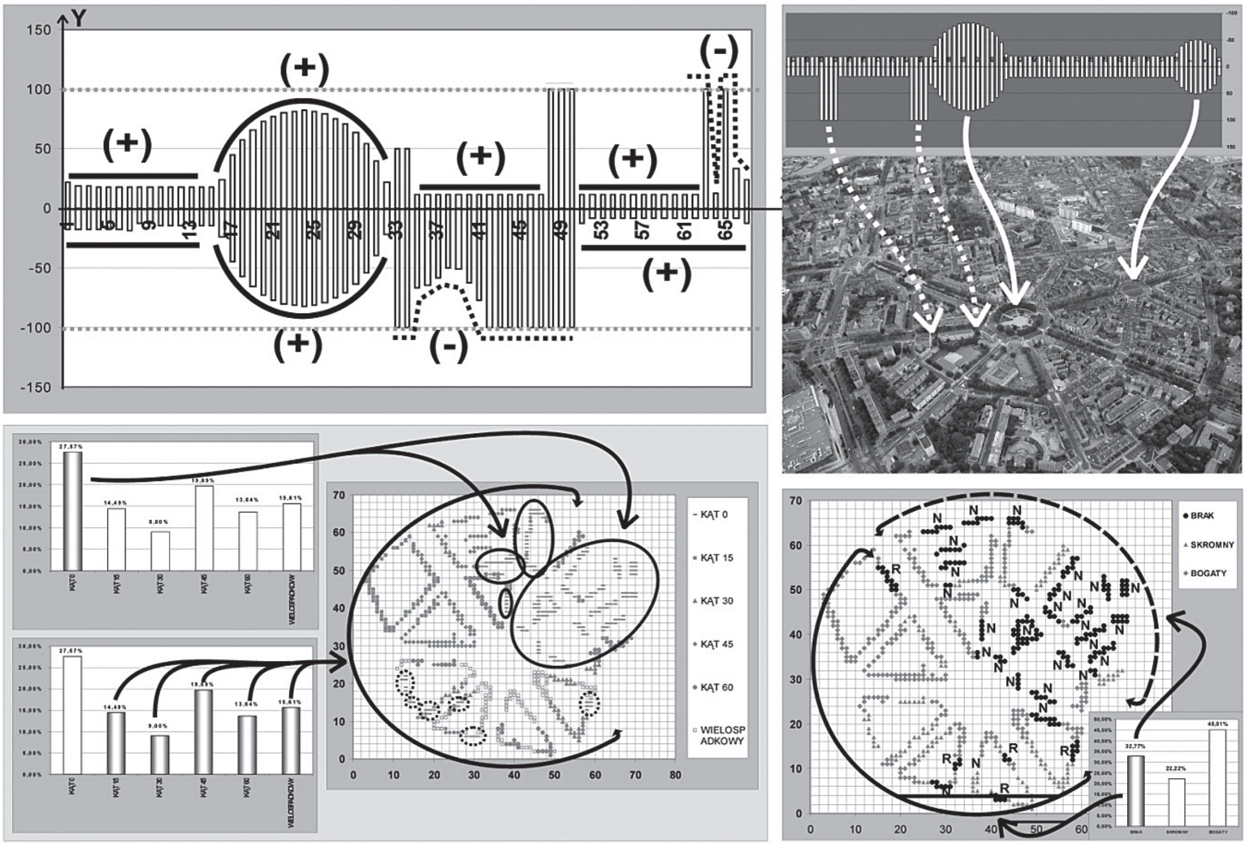

Fig. 1. Examining building facilities in centre of Szczecin while using Spatial Continuity Diagram and histograms and electronic inventories. By W. Marzęcki

on analysing urban structures using unique spatial research methods.

They have been applied in the virtual model of Szczecin and computer analyses of the city of Lublin.[2] Experience gained is a good basis for further research on urban space while using the Spatial Continuity Diagram Method. According to the method, analyses of architectural and urban features and their categories lead to developing information sets in the form of data diagrams. Conclusions of the research, which provide guidelines for rebuilding or extending existing urban space, are developed into a set of data that can be used by a designer who is free to distribute particular categories of analysed features in the design. Expanding the research with 3D aspects of specific features may significantly facilitate defining the essence of development focused on existing buildings and their contemporary transformation in the spirit of spatial continuity. Previous analyses have always considered the 3D aspect of urban space, for instance by analysing building heights.

However, due to shortage of the then virtual city models, it was difficult to analyse mutual relations between particular facilities and their clusters in a broader spatial context. Although such attempts were made during Spatial Continuity Diagram analyses by studying 'typological paths' and degree of 'feature category distribution', the research were based on questionnaires and 2D analyses of maps. The current use of a more suitable 3D urban space model as a research tool enables the research to cover entirely mutual relations between particular blocks of the urban development.

Major advancement in virtual city model animation may enrich Spatial Continuity Diagram analyses with issues pertaining to the perception of urban space while taking into consideration the time/distance factor. We tend to perceive the surrounding world not in a static manner but as a series of consecutive occur-

[1] The Research Team of the 'Urban Planning Cyber Centre' has been established at the Faculty of Civil Engineering and Architecture, Westpomerania University of Technology of Szczecin. The team comprises: Prof. dr hab. inż. arch. Waldemar Marzęcki, dr inż. arch. Klara Czyńska, dr inż. arch. Paweł Rubinowicz, dr inż. arch. Adam Zwoliński.

rences, including their 3D aspect. The analysis of the urban structure, seen as a series of consecutive spatial experiences, brings us closer to the real perception of the surrounding urban space.

In the previous research on urban space which used the Spatial Continuity Diagram, data from analyses were collated in the form of 2D diagrams. The diagrams showed percentages of particular feature categories rather than their locations in urban space. At the moment, the diagrams have a different form. They have been transformed into 3D schemes. Instead of applying more attractive imaging of a flat chart by using blocks to present particular elements, the main idea is to use the spatial structure to express fully the complex nature of urban space in question. Contrary to previous diagrams used in the method, data sequenced according to their values are not distributed in the space of a 3D diagram. Specific values are not decisive regarding the positioning in the diagram but instead the most important issue is their spatial location in the urban structure. In practice, data are placed on a time or distance line (depending on research assumptions). Such a distribution of data is expected to reflect the sequence of specific consecutive phenomena (Fig. 2b). If we consider the physical distance between particular spaces while examining the urban structure, the diagram will include the distance line in metres or kilometres. A phenomenon itself can be analysed while taking into consideration time elapsing before a given distance between urban spaces is covered. The distance line defines distances between specific phenomena. The use of a time line allows for differences in analysing the same spatial phenomena[2].

In the case of identical distance between spatial phenomena, time needed to cover the distance between them starts playing an important role. By shortening the time to move from point A to point B within a given urban structure, we may completely change the perception of the space.

In general, we may assume that the shorter the time, and consequently higher speed of motion, the

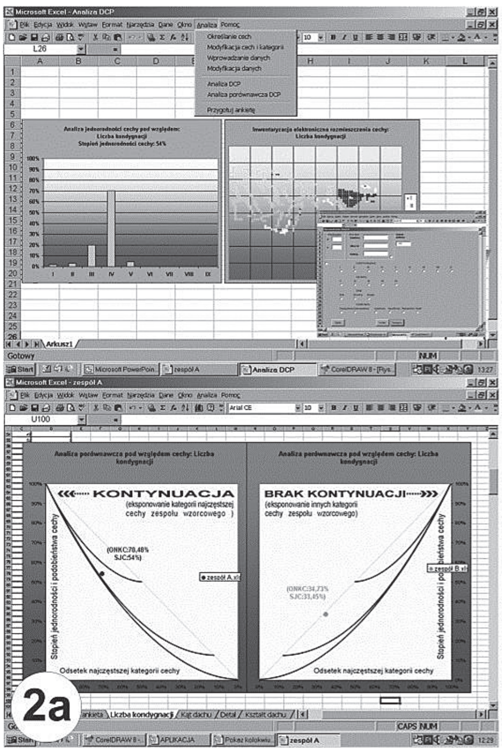

Fig.2a. Spatial Continuity Diagram analyses using computer application for Microsoft Excel. By W. Marzęcki and R. Sokołowski.

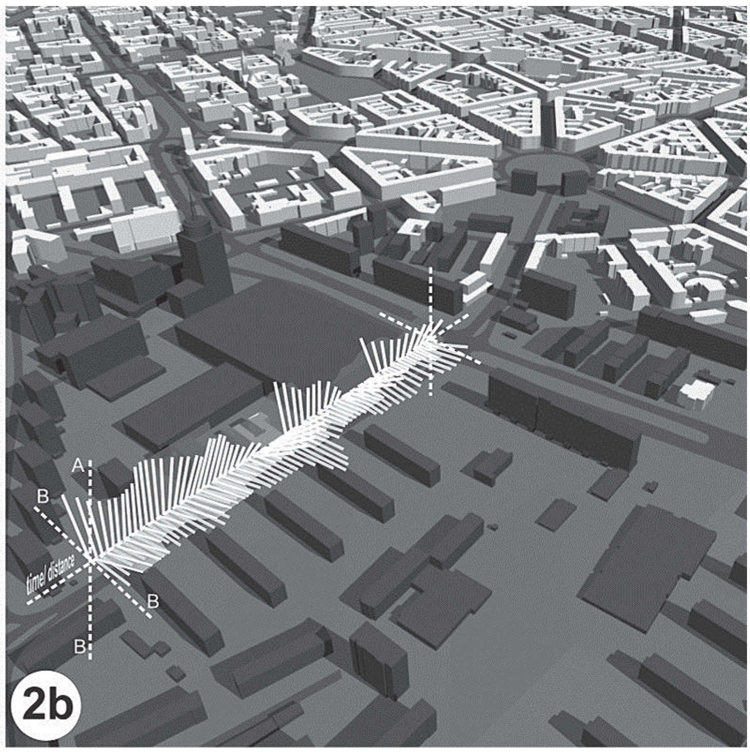

Fig. 2b. Using virtual model of Szczecin city centre for Spatial Continuity Diagram research including new form of uniformity diagram containing features on time and distance line. By W. Marzęcki

[2] K. Czyńska, *Panorama ze wzgórza Czwartek w Lublinie – analiza widoczności zabudowy metodą kątów widokowych*, „Przestrzeń i Forma", 15/2011, Szczecińska Fundacja Edukacji i Rozwoju Addytywnego SFERA. 303 s.

more eager we are to generalise the perception of the urban space in question. We then tend to focus on its major features only. When we take more time to cover a given distance and thus reduce our speed, we can pay more attention to smaller details as the expense of a more general perception of the urban space. In the 3D Spatial Continuity Diagram, the time/distance line is an axis Z. The traditional Cartesian coordinate system is perpendicular to the time/distance line in the new 3D diagram. Data are distributed in space of particular octants within the 3D diagram. Combining potential of studying virtual city models with analytical methods of the Spatial Continuity Diagram should contribute to a better definition of spatial issues in urban structures.

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PARAMETRIC, GENERATIVE, EVOLUTIONARY, ORGANIC AND BIONIC ARCHITECTURE – A NEW LOOK AT AN OLD PROBLEM

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Abstract
The constant development of all areas of human life forces the continuity of an awareness limited to individual selected issue, but also imposes searches in broader fields of science. The same phenomenon also did not miss the architectural design. Dynamism of changes and participation, among others, mathematics, computer sciences or biology design entered confusion and false perception of the definition of the new methods of design.
The main goal of the article is to organize the principles that govern parametric, generative, evolutionary, bionic or organic design. The basis for distinguishing between these issues is to define the objectives of the initial formation of a solid object. Evolution of changes in modern design techniques is also a great record of the history of human conscious creation of an architectural form

Keywords: parametric; generative; bionic; architecture; design

Concepts unfortunately have this in common that in general use often specify incorrectly some phenomena. Because of the very rapid development of architectural design method in recent years, appellation "parametric architecture" is mistaken with organic architecture, evolutionary architecture is mixed with generative architecture and around this term appears somewhere bionic design.

The introduction of new design techniques in last decades, gave opportunities to design very complex geometry objects, what with precision may be created only In computer version. At some point in architecture seemed that is nothing spectacular to created, architects began to use new techniques which are commonly used in other fields.

The first technique, which has made a quantum step in architectural design, is form parameterization. In contrast to the completely manually method of creation a three-dimensional computer model, in this case the object is created on the basis of equation (parameters) between its elements. Using mathematical method are described equations between, for example, basic points and the surface based on these points. This method seeks to create a graph hierarchy where the location, shape and size of some objects are dependent on the basic elements. This gives you the opportunity to create a model in which modifications in the geometry of the initial phase of design modify an entire model from beginning to end. Programs which are using to parametric design tools are extremely precise and require very precise construction of the model. This technique allowed for the development of design objects with bspline surface geometry and, unfortunately, are now mainly associated with this shapes. Most of us completely forgot about the possibility of using this technique also in the design of the traditional, rectangular objects. It is worth recalling that one of the most parametric object in the world is a cube. All the quantities occurring in it: the surfaces of the side walls, the length of the diagonal of the side wall, the length of the diagonal of the cube, and the volume depend of from one value: the length of the edge.

A more complex approach to design presents a method of creating generative architecture. In that case, the architect becomes a „architecture programmer" to limiting use of pencil. Using advanced algorithms, designer describes how to create object that is shape which finally is generated by the computer. Shaping an object form, is done only at that level, which was determinated at the beginning by the architecture.

An example of generative design is the structure shown above. With its generating inflicted strength requirements that a structure should have to meet, as well as a similar basic shape is a sphere module. Strength characteristics associated with the determination of the density and the type of filling. This structure once generated does not change.

Development generative design is design of evolutionary, with to the objects created by algorithms added aspect of the possibility change it over time. In other Words: the principles with creating forms rules are modified during over time due to external factors. We are able to predict result of generative algorithms, problem is In the design of evolutionary. We rely on only on interactions made by computer with that case include so many factors. The end result is very difficult to determine before starting the simulation model of evolution.

Both of these methods are based on initial Assumptions, at the expense of created architecture Visual effect. But In most cases, the complicated geometry expression of evolutionary model at the final effect is really amazing.

The structure presented above, although we cannot see it, is in constant motion, looking for the most optimal system of rods, which would meet the given criteria. When we allow this metal structure to "grow", in the final dimension achieve the effect will not be perfect, but will be close to the ideal system, which, like a living organism in the process of evolution in the most accurate way will suit your requirements.

In some aspect, generative and evolutionary design also uses parameters like a basis for creating objects, but a record form this parameter is different that methods are taken as a separate filed of modern design technology. What connects of the three methods is that fact- they allow to achieve the optimal form of the object, after tested on a short time different shapes and materials. Consequently we are able to satisfactory and quickly adjust our form to conditions with created by us structure should have.

Turning to the bionic way of creation architectural forms we should begin by determining the difference between bionic shapes and organic shapes. To the extent that organic character refers to the appearance and aesthetics of objects and it only seeming to imitate natural forms, the bionic principles of functioning of organisms and their transfer to human life in the most original, natural version. Entering already in issues of biology architects are trying, in the most accurate way, to map the structures created in nature. This mapping not only applies to the organisms, animal and floral, but also to forms created by plants and animals and their behaviours. To describe mathematically the processes occurring at the level of cell formation, and hence the whole structure in nature is still impossible, but in a more general way this rule uses the form-finding method.

Most of all, this method goes with very reasonable way with material optimization. It is assumed for the creation of structures that are formed using the method of the flow of forces. It is very closely related to the structures existing in nature, which, because of a multimillion evolutions and modification of self- construction are excellent examples of material and construction optimization, which is dictated by the chance of survival and the ease of obtaining nutritional value. This simple rule, of survival at the lowest cost, is increasingly being used in our everyday life. After thousands of years, mankind has reached a point where it is no longer able to create things so original and more useful which can delight us all. It seems that we are becoming more rational come to our existence and we return to the original solution offered us by the nature. On the other hand, only now, at the moment of technological development, we can examine the organisms at the cellular level to detect the basic principle of their operation. Our weakness in this area now includes the inability of mathematical notation of all these processes, which are linked together, and fast processing of data, which in the case of the simulation of natural processes require thousands of iterations per second.

A completely different concept , with respect to methods above , seems to be organic architecture . Organic design only draws inspiration from the natural world and the forms created in accordance with this principle in most cases are very plastic and rounded . Design technique , whose origins date back to the first half of twentieth century, does not specify precisely way how to create forms - it is only the result of the rich imagination of an architect who uses previously observed in nature in shapes which he creates. Incorrect identification of this trend is mainly used for buildings of a smooth line of shapes, which in no way relate to the world of fauna and flora. Also, bionic architecture is incorrectly included to this trend. Organic architecture does not preclude the creation of models inspired by nature with parametric or generative techniques, however, relationships between the parameters of these objects do not overlap with relationships occurring in nature.

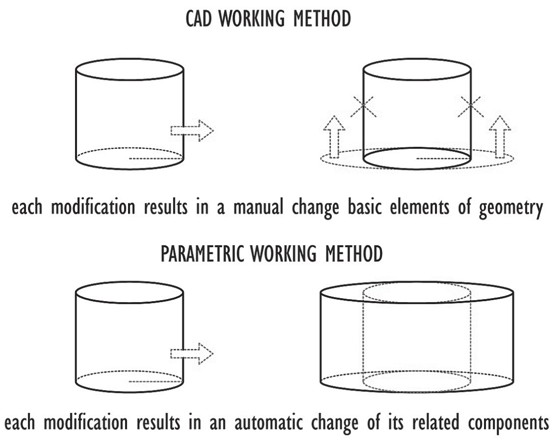

Fig. 1. Diagram of the difference between designing in CAD and parametric design. Own collection

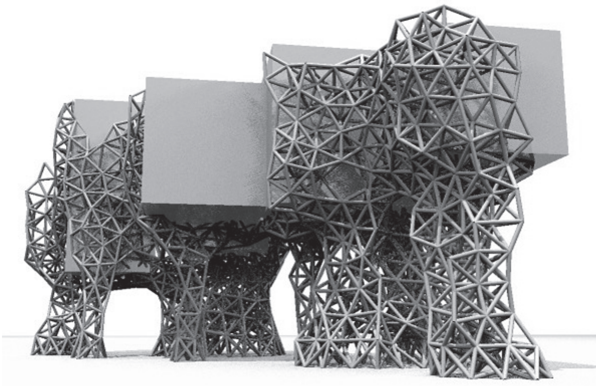

Fig. 3. Illustration of evolutionary metal structure which is changing during the time. *Parametricism*, (2014, January 10). Retrieved from: http://www.parametricdesign.net/wp-content/uploads/2009/06/5boxes_embraced_v2_.jpg

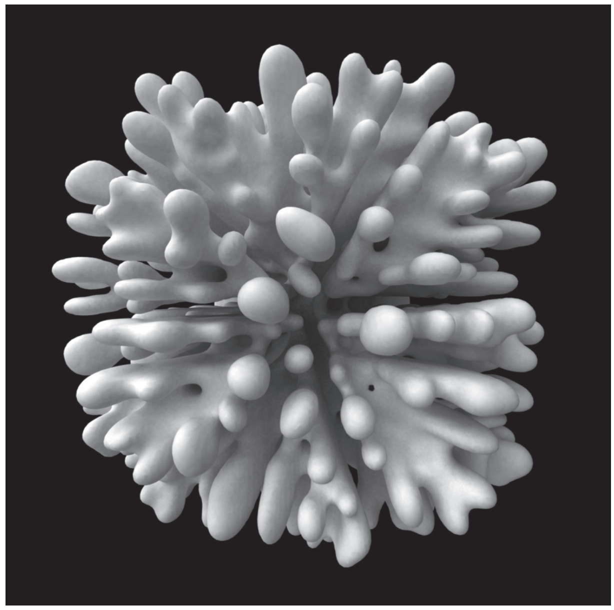

Fig. 2. A simple example of generative structures relating to natural structure;. Nervous System, *Generative Design Work* (2011, October 21). Retrieved from: http://wewanttolearn.wordpress.com/2011/10/21/processing-toxiclibs-n-e-r-v-o-u-s-and-biothing/

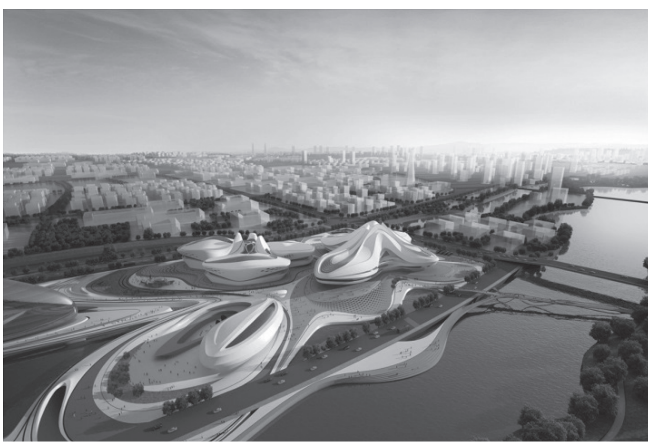

Fig. 4. The Grand Theatre project, which is the focal point of the Changsha International Culture&Arts Centre, China. ARCH 20, *Changsha Meixihu Internationl Culture&Art Center- Zaha Hadid* (2012, March 07). Retrievered from: http://www.arch2o.com/changsha-meixihu-international-culture-art-centre-zaha-hadid

Fig. 5. The Beko Building Project in Belgrad, Serbia. Galante Meredith, *Zaha Hadid Reveals Her Zany Plans For A Defunct Factory In Downtown Belgrade* (2012, November 27). Retrieved from:http://www.businessinsider.com/zaha-hadids-beko-building-in-belgrade-2012-11

Fig. 6. AA Summer Pavilion was built by students in 2008. *Swoosh Pavilion at the Architectural Association*, (2008, July 14). Retrieved from: http://www.dezeen.com/2008/07/15/swoosh-pavilion-at-the-architectural- association/

If you look well, known by all of us Zaha Hadid buildings, in no way contain specific references to nature. Architect's case hand allowed for creation objects that seem to be only a phantom of elements occur in nature. They give us a clear association with the natural world, but are not referring to her perfectly.

Because of the fact that aforementioned techniques are relatively young technologies of architecture design and still being developed, not much projects which use them in 100% we can present. In the architectural objects we can only find single elements, which are created in accordance with these principles. The most common used technology today is a parameterization of the form, which refers to many aspects of creating buildings. It is used, among others, in the optimization of materials, optimizing the shape of the object due to the effect of sunlight or wind, but it is also very helpful in creation of elements with bspline geometry. Due to the complex shapes and forms some of parametric objects required to create an individual construction system of which elements also have a very complex geometry shapes. Construction of these facilities could not exist, at a cheaper version without from panelisation, but primarily without digital fabrication, which allows us in precisely way to produce structural elements.

Projects of parametric pavilions, which are every year built by students of the school of architecture in London, AA, every time use some kind of fabrication system. Very cheaply they can create objects of considerable span with the use of parametric design tools.

In conclusion – not every parametric object is an organic object and not every organic object is parametric. Organic architecture is not bionic architecture, and however, can be connected very closely with generative and evolutionary design, in most cases are the result of manual modelling liquid form . However, if in the process of evolutionary algorithms utilize the principles found in nature and accurate way to determine the natural processes, then the most we deal with the use of biometric in architecture.

And that is after several centuries of environmental degradation it becomes a source of inspiration for us to reduce the cost of our existence on Earth. After a time when we were staring blindly at the new technologies, we more often look not only at what we eat and how we take care of the purity of the environment, but also try to find a way of economic survival. The only question is how quickly we can restore the natural processes over which nature has worked for millions of years of evolution since of the earth beginning?

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HYBRID DESIGN APPROACH IN EDUCATION USING A PROGRESSIVE RULE-BASED DIGITAL DESIGN DEVELOPMENT. SOPOT COLLEGE EXPERIENCES

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Abstract
Architecture itself could be considered as a hybrid of engineering and *beaux-arts.* Nowadays there are many tools that can help architects develop and optimize their innovative concepts. This paper describes a hybrid design approach based on combination of traditional architectural design and computational design (Fig. 3) based on study program in Sopot College, Faculty of Architecture. The paper explores the field of cooperation and hybrid interaction between manual and automated methods of developing architectural concepts.
The results show that student are eager to experiment with new methods of design. Moreover, the results they achieve in this way are far more innovative and complex. Knowledge of hybrid design methods may contribute to expansions of avant-garde architecture and research-based design methodology.

Keywords: hybrid interaction; design methods; education process; computational design

ARCHITECTURE, EDUCATION AND HYBRID ENVIRONMENTS

Architecture for ages has been a discipline tied strongly to construction. On the other hand, it has always had a strong connection to the final arts as well. In this way architecture has always been a hybrid one, connecting world of art with the world of engineering.

However, since early 1990s, when computer animation was incorporated into architectural design practice[1], we have been observing a greater and stronger connection between architecture and other disciplines, including mathematics, physics, material technology, but also biology, chemistry, genetics under the broad umbrella of rapidly developing information and communication technology and new media.

According to definitions used in life sciences, a hybrid organism is one created by combining characteristics and features of two parent-organisms. Hybrid is an *offspring of parents that differ in genetically determined traits*[2]. Other definition, closer to architecture defines *hybridization (a.k.a. morphing)* as a process in which an *object changes its form gradually in order to obtain another form (…)* and *consists basically of the selection of two objects and the assignment of in-between transitional steps*[3]*.* Following this definitions and applying them to architecture, an architectural hybrid would be a creation done by combining features of two and only two disciplines. In this way hybrid environ-

[1] Greg Lynn presented a hybrid between architectural design and animation in 1993, introducing the *folding* term, and later in 1999 in his book *Animate Form* (G. Lynn, 1999).
[2] Encyclopaedia Brittanica, http://www.britannica.com/EBchecked/topic/277999/hybrid (access: 02.2014)
[3] K. Terzidis, 2006, p. 97.

ments for architecture should be described as interconnection of two source environments, e.g. fine arts + building technology, form design + plant morphology[4], form design + mathematics (fractals)[5], functional layout planning + topology and systems theory[6].

Among various hybrid environments for architecture there is however one, which has become an interesting field of experimentation in last decade, namely computational design of architectural form. As already has been presented, this approach bases on various interdisciplinary connections, often connected with evolutionary or emergent mechanisms[7]. This kind of approach could be generalized to a hybrid environment created by architectural design and computation methods.

Innovative education methods / models more often include new media in the teaching / learning process. By new media we mean not only audiovisual techniques (videofilming, video-based lectures, interactive presentations, etc.) but also techniques such as virtual environments[8], edutainment and game-based learning & gamification[9]. It seems that recently computational techniques involve acting with deeper layer of human to computer interaction[10] in the higher level education. In practice it means that students are encouraged to communicate with a digital machine beyond the haptic interface offered by the system manufacturer. It involves learning some basic and advanced computer programming language skills by students. After this, they are facing new possibilities to achieve results not possible with traditional way if interaction, limited to the built-in, standard software / hardware interface. Education in the Faculty of Architecture in Sopot College is the first degree level of higher education in architecture. The study is divided into three curricula with the undergraduate titles respectively:

- interior design – bachelor of interior design degree
- landscape architecture – engineer, landscape architect degree
- architecture and urban planning – engineer, architect degree, the first level towards the profession of a licensed architect. Here, the study curriculum follows the Ministry of Science and Higher Education's education standards for the architecture and urban planning field of study.

Recently, Sopot College is trying to implement and develop a Problem-based learning method, which in architectural education means more Project-based learning and design approach combining the following:

- architectural / urban design studios – subjects varying from housing through office buildings to urban quarters
- and public spaces in the city,
- adaptive learning – each student has a different problem to solve using different skills,
- relevance-oriented learning – student sees the aim and application of the knowledge and skills he acquires during courses.

The studies in Sopot College are conducted in two separate path: a full-time study (5 days a week) and a part-time study (2 to 3 weekends per month). Sopot College is also developing the digital design techniques, from basic digital initiation in the first and second year through advanced digital techniques to computational tools in the third and fourth year. As the basic and advanced techniques still involve manual approach through the standard interfaces of the software used, the computational approach is oriented more on an idea of **hybrid design approach** between traditional architectural design studio and computational design techniques.

As such, it explores organic and digital mind cooperation, being a PBL-oriented course combination. The digital development implements automated techniques, involving rule-based approach based on process initiation and evolution.[11]

Today the challenges of sustainability demand that cultural production today reclaims its old sense of ambition and scale; that it once again embraces the possibilities of total design.[12] In Sopot College every design task has to be performed with consequent approach including conceptual and technical development. The techniques to achieve the goal are various and slightly differ from course to course. Most of the courses are strongly connected with the main design course appropriate for a given year / semester and

[4] M. Hemberg, 2001 and P. Prusinkiewicz, A. Lindenmayer, 2004.
[5] K. Terzidis, 2006.
[6] J. Cousin, 1970, S. Latour, A. Szymski, 1982, W.J. Mitchell, 1984.
[7] G. Pęczek, 2007, p. 176-177.
[8] S. Zedlacher, A. Wiltsche, 2010, p. 433-442.
[9] A. Guzik, M. Mizerska, W. Wiśniowski, J. Gałecka, O. Nerc, M. Zalewska, 2013.
[10] A. Sowa, 2005, p. 229-236.
[11] K. Terzidis, 2006, p. XII.
[12] R. Koolhaas, H.U. Obris, 2011, p. 21.

they remain in the domain of traditional design studio as presented previously in the paper.

Students first develop a building architectural concept during the architectural design studio course (main course). Then in the Computational Design Techniques course (complementary course) they use digital techniques to enhance and augment the project of the building (Fig.1).

With the complementary course on Computational Design Techniques, the aim is even higher. The laboratory is held on 5^{th} and 7^{th} term in architecture and urban planning studies program. The tasks, that students were working on during the design course, were developed and analysed using advanced design techniques that involved parametric design, scripting and basic analysis of environment and selected sets of pressures, which were then used as form generators. The purpose was not only to achieve a *utility and beauty, that are definitory for the discipline as a whole*[13], but also to be innovative. Patrick Schumacher came up with the questions, that are relevant to the development of modern architecture: *But do utility and beauty cover all the dimensions of all possible architectural evaluations? Does this universe have only two evaluative dimensions? Is the pursuit of functionality and formal resolution all? What about novelty/originality?*[14] At the very beginning of the course the same question is given to the students for consideration. Most of them admit that novelty/originality are features that are highly important for them and they are willing to pursuit them in their designs. So if the design is not only about two main architectural evaluation but also novelty, we are facing the avant-garde architecture: *the double code of architecture is augmented by third code (authors: novelty) that is exclusive to architecture's avant-garde segment*.[15]

As the main course (architectural design studio) is focused on designing an office building using the more traditional human based approach, the complementary course (computational design techniques) combines this methodology with more avant-garde one that uses a computational design method. This way we create a **hybrid working environment** for students. *Design via scripted rules is replacing design via the direct manipulation of individual form. Scripts can uniquely enhance both the design process's generative power and its analytical power. The ability to combine the explorative potential for surprise discoveries with the guaranteed adherence to key criteria is the unique advantage of the new computational techniques. Through these techniques the design process simultaneously gains breadth and depth.*[16] Students not only gain knowledge of typical designing process, but also learn how to improve their working environment and their workshop with different techniques and methods. The effects are of course varied, depending on capabilities of different individuals.

Students are working on their projects using multiple design techniques from the basic ones like small scale model of the building and two-dimensional caad environment to more advanced ones like 3d modelling and parametric design using McNeels' Rhino, with the Grasshopper plugin. The total number of 77 student took part in the course, 40 of them being full time students. Most of the students (about 73%) are using the advanced techniques mainly for facade design. However only some (about 18%) use it for both the facade and form of the building. Surprisingly only a few (about 9 %) used parametric design for developing a detail only (Fig.2). What is worth mentioning is that about 70 percent of students, after getting familiar with new design methodologies are concerning the hybrid-working environment most suitable for their design needs.

CONCLUSIONS

The profession of an architect has always been a hybrid one. Nowadays one of the main hybrids is that combining traditional manual architectural design methodologies with automated, digital and computational ones creating a hybrid design domain (Fig. 3).

The presented Sopot College educational programs are introducing this hybrid design approach to students in form of laboratory courses (main and complementary). Initially the understanding and knowledge of hybrid design techniques is on low level. Therefore it is important to present and teach in a form of complex design course. The positive feedback from students is a proof that combined design techniques result in more developed and complex output. However, if the techniques are not fully understood, they can mislead to a design result that is not logical and consequent. That phenomenon could become a major problem for quality and utility of design. To avoid this kind of occurrences it is highly recommended that learning of computational techniques is preceded by adequate theoretical knowledge. Knowledge of hybrid design methods may contribute to expansion of avant-garde architecture and research-based design methodology.

[13] P. Schumacher, 2011, p. 233.
[14] P. Schumacher, 2011, p. 228.
[15] P. Schumacher, 2011, p. 233.
[16] P. Schumacher, 2012, p. 311.

Fig. 1. The hybrid interaction between main and complementary courses; source: by authors

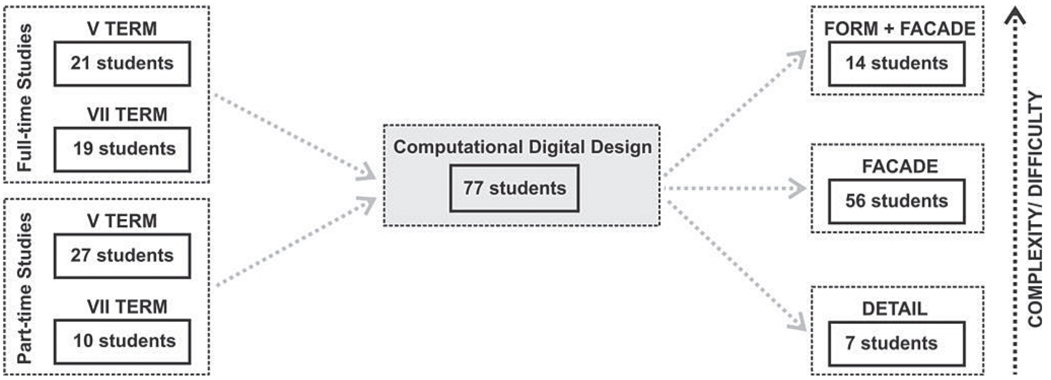

Fig. 2. Computational Design Techniques course structure; source: by authors

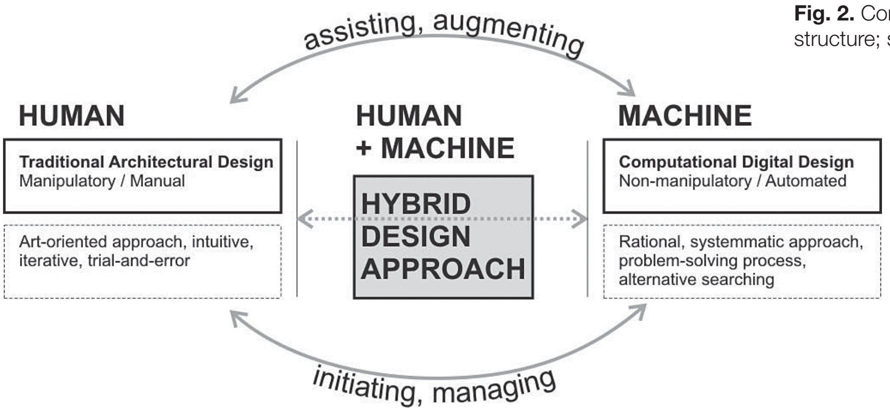

Fig. 3 Hybrid Design Approach in architectural design; source: by authors

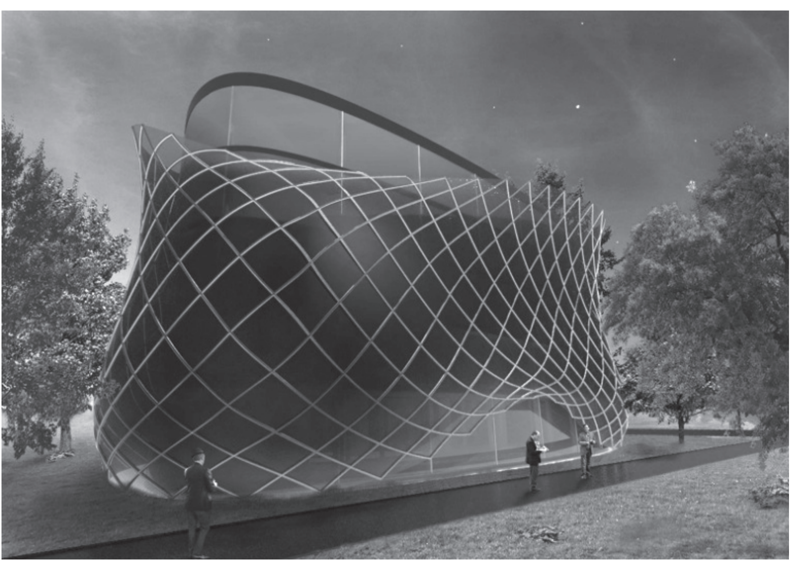

Fig. 4. Form+Facade, Office building, Zawadzki Lukas, Sopot College

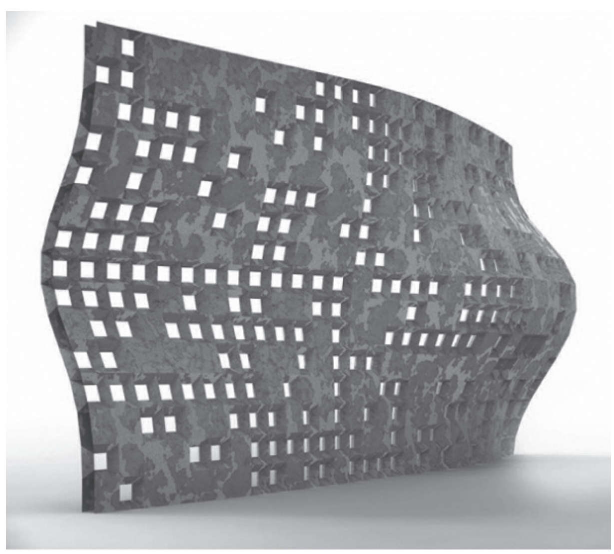

Fig. 5. Facade, Front curtain wall, Stępkowki Radosław, Sopot College

Fig. 6. Detail, Craft Table, Jurasz Emilia, Sopot College

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DEVELOPING A PARAMETRIC URBAN DESIGN TOOL. SOME STRUCTURAL CHALLENGES AND POSSIBLE WAYS TO OVERCOME THEM

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Abstract
Parametric urban design is a potentially powerful tool for collaborative urban design processes. Rather than making one-off designs which need to be redesigned from the ground up in case of changes, parametric design tools make it possible keep the design open while at the same time allowing for a level of detailing which is high enough to facilitate an understanding of the generic qualities of proposed designs.
Starting from a brief overview of parametric design, this paper presents initial findings from the development of a parametric urban design tool with regard to developing a structural logic which is flexible and expandable. It then moves on to outline and discuss further development work. Finally, it offers a brief reflection on the potentials and shortcomings of the software – CityEngine – which is used for developing the parametric urban design tool.

Keywords: parametric design; urban design; building footprint; sequential hierarchy; design tools

INTRODUCTION

The overall aim of the research presented in this paper is to develop a parametric urban design tool. While the research is in its early stages of development, the aim of the paper is to present some initial results and to outline further development. Parametric design is not new, nor is its application to urban design. Yet, although different approaches to parametric urban design have been developed – from serving analytical purposes to serving design generation purposes – only few attempts (Jacobi et al., 2009) have been made to develop a design tool to facilitate stakeholder involvement.

When undertaking the task of developing a parametric urban design tool, three structural and organizational aspects must be considered: parametric flexibility, structural logic, and interaction design. While parametric flexibility is core to all other considerations and thus must be considered at all times, a structural logic must be developed at the outset and subsequently adapted or moderated according to design development. And while interaction design is ultimately important once the tool is put to use, it need not be the focus of design at the early design stages. Hence, the focus of this paper lies on developing a structural logic for a parametric urban design tool which is parametrically flexible and easy to use.

Different parametric design softwares have different strengths and weaknesses when it comes to meeting these three aspects. For our test case, we have been using CityEngine, which is a procedural design software targeted specifically at urban design. While we will not offer an evaluation of different software packages for their fit with our purpose in the context of this paper, we will, however, briefly discuss the pros and cons of using CityEngine.

BRIEF OVERVIEW OF PARAMETRIC DESIGN APPROACHES

Parametric design is a design method that allows the designer to rapidly evaluate design scenarios based on a combination of datasets and rules, in an iterative design process of defining and adjusting parameters and relations (Burry, 2005). This method can be applied to designs at any scale. However, the scope of this paper is to explore its application in urban design.

Parametric urban design as a method has been developed to involve the use of urban data to facilitate an interactive design system (Beirão et al., 2011). Using a system, or tool, geometries in a computer model are updated instantly according to changes in data or design criteria, whether it is GIS data or stakeholder feedback. This rapid production of new geometries potentially improves the quality of the design, as the design goes through more iterations than when using traditional design methods (Burry, 2005).

Parametric design has been used in various situations and industries, spanning from entertainment to urban planning (Watson, 2008); while parametric design applied in urban planning has the power and potential to be used as an outright simulation tool for urban development (Leach, 2009a), it is often used as an analytical tool for various purposes (Gil & Duarte, 2008; Chiaradia, 2009). Some designers have proposed to take the tool one step further, turning it into a distinct architectural style (Schumacher, 2009), while others only use the tool for visualization of urban data (Kroner, 2011).

Parametric design is widely used as a method of generating urban structures bottom-up, in a generative, emergent manner (Batty, 2009; Leach, 2009b, c; Roche, 2009). Using GIS data as parameters in a parametric design is a promising technical potential of the tool (Beirão et al., 2008), while the participatory aspects of a parametric design process holds great social potential (Jacobi et al., 2009). Using parametric urban design, stakeholders can be presented to actual design scenarios even in early stages of the design process (Steinø et al., 2013).

The approach to parametric urban design adopted in this research is based on the notion that parametric design is neither a simulator, nor an architectural style. Rather, parametric urban design is considered a tool to generate different design scenarios faster during the design process, as well as facilitating stakeholder involvement. It is important to note that analytical models generated parametrically are not design models, but only shapes to be evaluated by the designer (Gil & Duarte, 2008).

INITIAL TEST CASE RESULTS

In any communicative urban design process, some aspects – or parameters – are more likely to be relevant to deliberate than others. And they are not likely to be the same for different design cases. In one case, density and building style may be topical, while in another case, environmental issues or the distribution of different building programs may be relevant issues to analyze and negotiate.

When designing a general parametric urban design tool, it is therefore crucial to consider how to achieve maximum flexibility when it comes to the design aspects which should be parameterized. On the other hand, the structure of the tool should also be kept as simple as possible in order to maintain overview. The challenge therefore, is to consider not only how to design the tool itself, but also how to make it easily adaptable for specialized needs. Furthermore, designing a parametric urban design tool is a collaborative effort which is likely to involve many people across time and space. Hence, the structural logic of the tool should also be carefully considered so that contributions from different designers can be integrated with one another. As designing a parametric urban design tool, as we define it, is essentially a scripting task, this involves devising a logic by which snippets of code can be brought together to work in a unified script.

In the real world, what may be relevant to discuss and vary are those elements which determine the physical appearance of a development. These may range from land use (as office buildings are different from housing) street width, site layout, building height, building shape (setbacks, height variations), to facade design. Hence, these elements (and more/others, depending on the actual case) must be controllable and therefore parametric.

In our case study, we have focused on site layout, building height and shape, and facades, we have also attempted at defining a set of logical steps to interlink between discrete sets of operations. In a procedural logic, the following elements build a sequential hierarchy in the sense that each step is a prerequisite for the next step:

1. Terrain >
2. Street pattern >
3. Block subdivision >
4. Site layout >
5. Building envelope >
6. Facade style

For any terrain, a number of different street patterns would be appropriate, relative to existing development and landscape elements. Street patterns define urban blocks which may or may not be subdivided into smaller plots. On each plot, different site layouts – e.g. perimeter blocks, tower blocks, row houses, patio houses, etc. – would be appropriate. Site layouts determine building footprints which, in turn, form the basis for different building envelopes. Buildings may be box-shaped, have setbacks, protruding elements, etc., as well as different roof shapes, all from the same footprint. And finally, the vertical surfaces of each building envelope may have different facade styles, typically according to land use and building type.

In terms of parametric flexibility, it is desirable to be able to combine subset variations on all these levels. As an example, for each site layout, it should be possible to apply any relevant type of building envelope. And for each building envelope, it should be possible to apply any relevant facade. Thus, there should be a unified interface at the end of each step, as well as a filter to define what is relevant. In a procedural logic, each step therefore have to result in a shape with a unified name for the next procedure to pick up from. And a switch must be built in to evaluate the conditions which trigger the relevant procedure.

In our case study, we have focused on the steps 4-6 for the parametric design. Hence, the street layout was was designed manually and urban blocks were not subdivided. Furthermore, urban blocks were rectangular and of similar size (app. 0,9 ha.) in order to minimize scripting for varying plot sizes and irregular plot shapes.

In practice, we used the following shapes which, by way of attributes link on to the next sequence:

1. The site layout sequence ends with shapes for
   a) Green spaces
   b) Building footprints
2. The Building envelope sequence ends with shapes for
   a) Facades (vertical surfaces)
   b) Roofs
3. Each facade sequence ends with different constellations of shapes for
   a) Walls
   b) Openings

For each plot, different site layouts may be generated. And for each of the different shapes in the list, variation may be achieved. “Building footprints” may result in simple block shaped building envelopes or building envelopes with setbacks or other morphological variations. “Facades” may lead to different sets of facade elements, which, in turn, may contain subsets such as different types of windows or variations in wall color.

The following examples show 1) different footprints, 2) how the Footprint > Envelope sequence may lead to different building envelopes from the same footprint, and 3) how the Envelope > Facade sequence may lead to different facades applied to the same building envelope.

Facades, more so than site layouts and building envelopes, follow generic principles for their generation. On the most basic level, any part of a facade is either a wall or an opening.[1] Openings may differ by width and height. Thus, schemas of horizontal and vertical sets of walls and openings can be defined for virtually any facade. Different facade symmetries as well as random facades may thus be defined by different schemas for the organisation of walls and openings.

On the more detailed levels, the position and size of openings relative to the floor height may vary, just as walls and openings may vary in design, color, material, etc. The following diagram shows a structural logic for the composition of a facade from sets of generic facade elements.

DISCUSSION

While the initial steps towards developing a parametric urban design tool for communicative urban design processes show promising results, there are still many elements to take into consideration. For our initial test case, we have worked in an artificial sandbox. Differences in actual plot sizes (which we kept constant) would require an evaluation of which site layouts would be appropriate, as well as of how to adapt the site layouts in each case. The same is true for irregular plot shapes and for sloping terrain.[2] Needless to say, our repertoire of typologies for site layouts, building envelopes and facades is still limited. But endless variations are imaginable. Additional typologies should be added, based on case by case requirements. At some point, it may be relevant to define sets of typologies to reflect regional, land use based, or other differences.

Not all building envelopes would be appropriate for any footprint, just as not all facades would be appropriate for any building envelope. Hence, a sort of filter must be implemented to make sure that meaningless combinations will not occur. This is also the case for different land uses. Housing and offices may not

[1] In addition, protruding balconies may be considered facade parts, as they have no building parts below or above them (apart, possibly, from other balconies). Balconies, however, have not been part of our initial study. Conversely – according to our hierarchy logic – bay windows and inlaying balconies must be considered parts of the building envelope, as they do themselves have facades.

[2] For our test case we did work on an actual terrain with different slopes. Yet, our scripts are not suited for very steep slopes and thus produce meaningless results in some cases.

fit equally well into any building envelope, and not all facades may fit both housing and offices.[3]

Also, more detail is desirable. Open spaces should be more differentiated in the form of different types of green spaces, paved spaces and functional spaces. Bay windows, porches/terraces, and inlaying balconies should be added to the building envelope repertoire, along with different roof types. Facades should optionally have balcony elements.

As mentioned above, street layouts have not been dealt with in the context of our initial test case. Whether and how street layouts can meaningfully be made subject to parametric design is yet to be clarified. It would be preferable to design street layouts within an integrated process of subsequent design steps. However, they may have to be designed using software other than CityEngine, as at present it does not have very flexible tools for the design of street layouts.

Finally, once the tool is developed and ready to be put to use in a collaborative urban design process, it should offer an easy and intuitive way to interact with the project model. This is important in order to be able to use the model responsively to different interests and ideas that might trigger parametric changes to the model. This is particularly true when non-designers and lay people are involved who are not able to make abstractions about form and space the way designers are.

SOFTWARE CONSIDERATIONS

As parametric urban design makes it possible to rapidly generate different design scenarios using parameters changes, it changes the design process significantly. By traditional techniques, it would be very time-consuming to create mock-up 3D models of different design scenarios. But with parametric design software this can be done in real time by adjusting parameters and rules. Thus, the designer is able to make design decisions on a better and more well-informed basis.

CityEngine is a powerful tool for parametric urban design. It is based on a simple scripting language, making it relatively easy for architects and planners to get a grip of the tool. However, using scripting as the mediator between design ideas and actual geometry presents a challenge when it comes to using the software in a design process involving stakeholders, as this interface is unintuitive to laypersons.

Some functionalities are still missing in making CityEngine a complete parametric design tool. While the content of streets and lots can be generated freely using scripting, the street structures themselves are confined to a number of preset options. This means that street structures in real urban design scenarios have to be created manually. If the shape of streets and parcels could be generated freely using parameters like landscape qualities, line of sight or functional requirements, this part of the design would also be open for parametric experimentation and evaluation.

CONCLUSION

While different approaches to parametric urban design exist, the approach adopted in the research presented in this paper aims at the fast generation of different design scenarios in order to facilitate stakeholder involvement in communicative urban design processes. Some initial results of a test case for the development of an urban design tool have been presented. Working within a sequential hierarchy from terrain to facade, the study has focused on the sequences from site layout over building envelope to facade. Despite the modest scope of the case study, the approach holds promise for the development of a powerful parametric urban design tool.

Nonetheless, much work still lies ahead in at least six areas. The tool must be able to cater for special conditions such as variations in plot size and shape. The repertoire of site layout, building envelope and facade typologies must be expanded. Filters must be made to make sure that elements at different levels in the hierarchy will fit together. More detail must be added. An approach to the design of street layouts must be developed. And finally, the interface of the tool must be considered in order to achieve maximum ease of use.

[3] Hence, while land use is not a geometric category per se, the requirements of different land uses are. For instance, office buildings typically have larger building widths, taller floor heights and more glass on facades than housing.

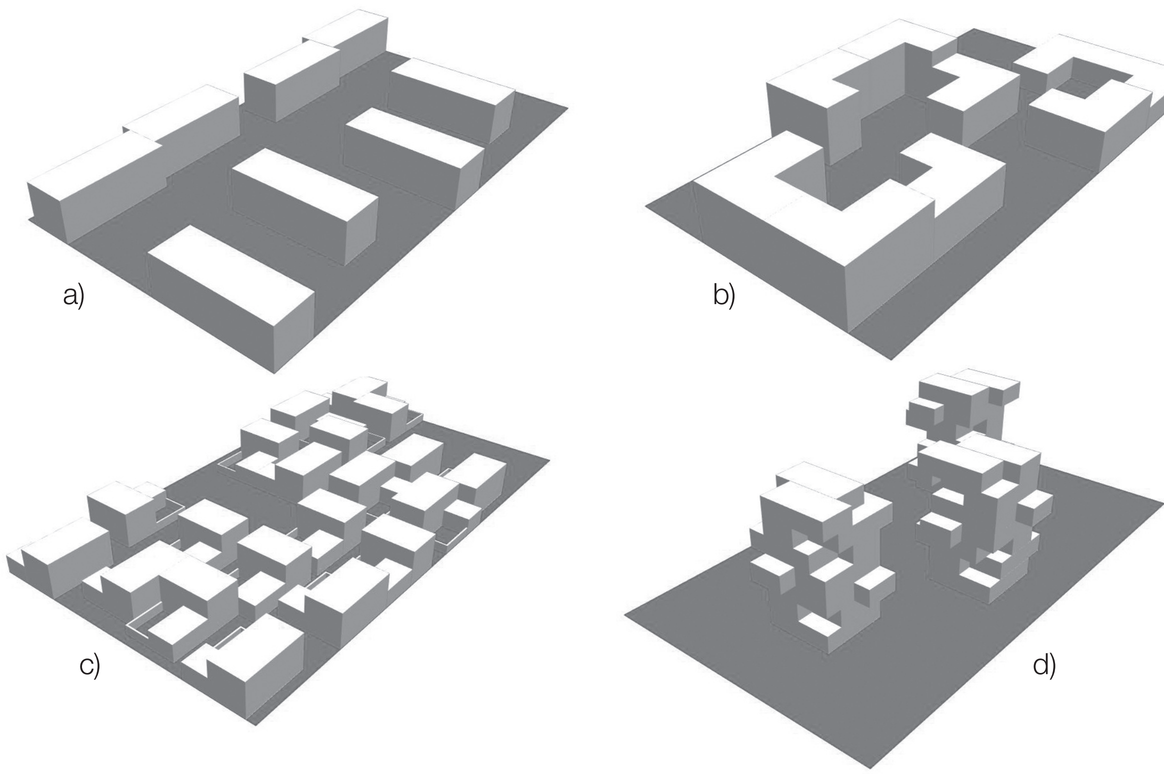

Fig. 1a-d. Different site layouts on the same parcel: a. Linear blocks, b. (semi-) Closed blocks, c. Patio houses, d. Tower blocks; by authors

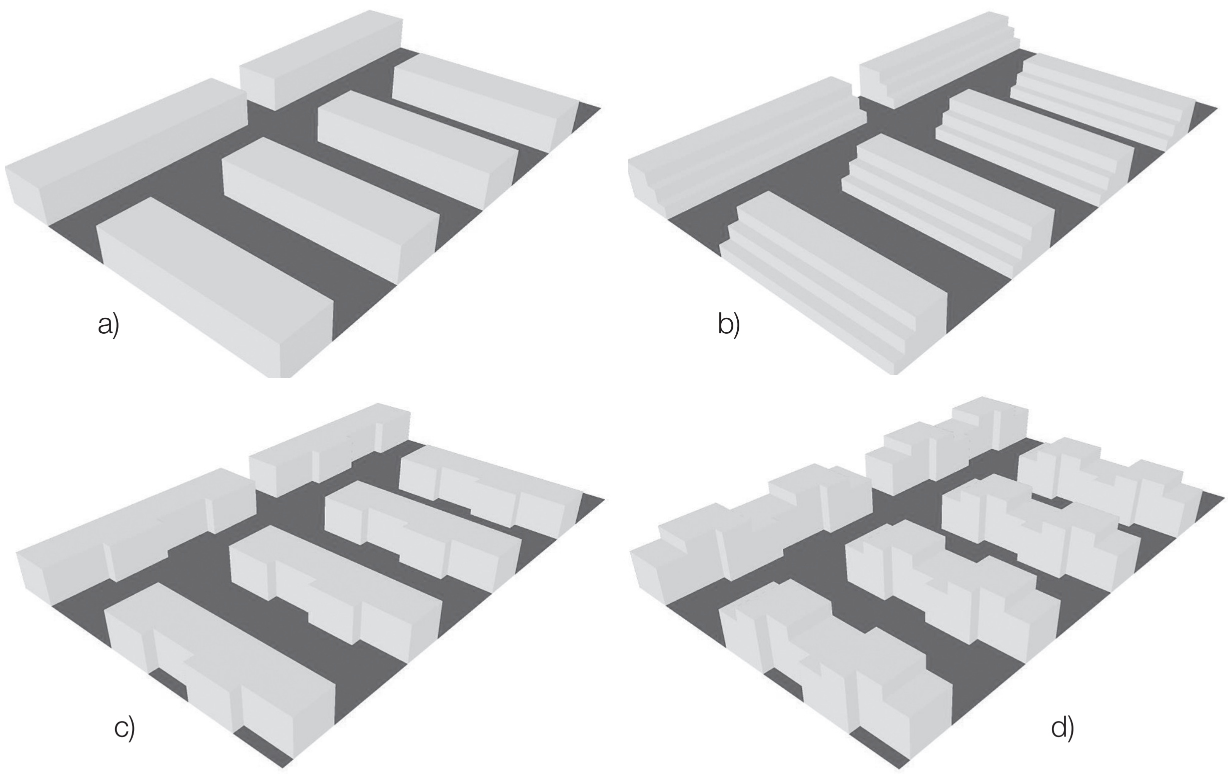

Fig. 2a-d. Examples of different building envelopes on the same footprint: a. Simple slab, b. Horizontal setbacks, c. Vertical setbacks, d. vertical setbacks and height variations; by authors

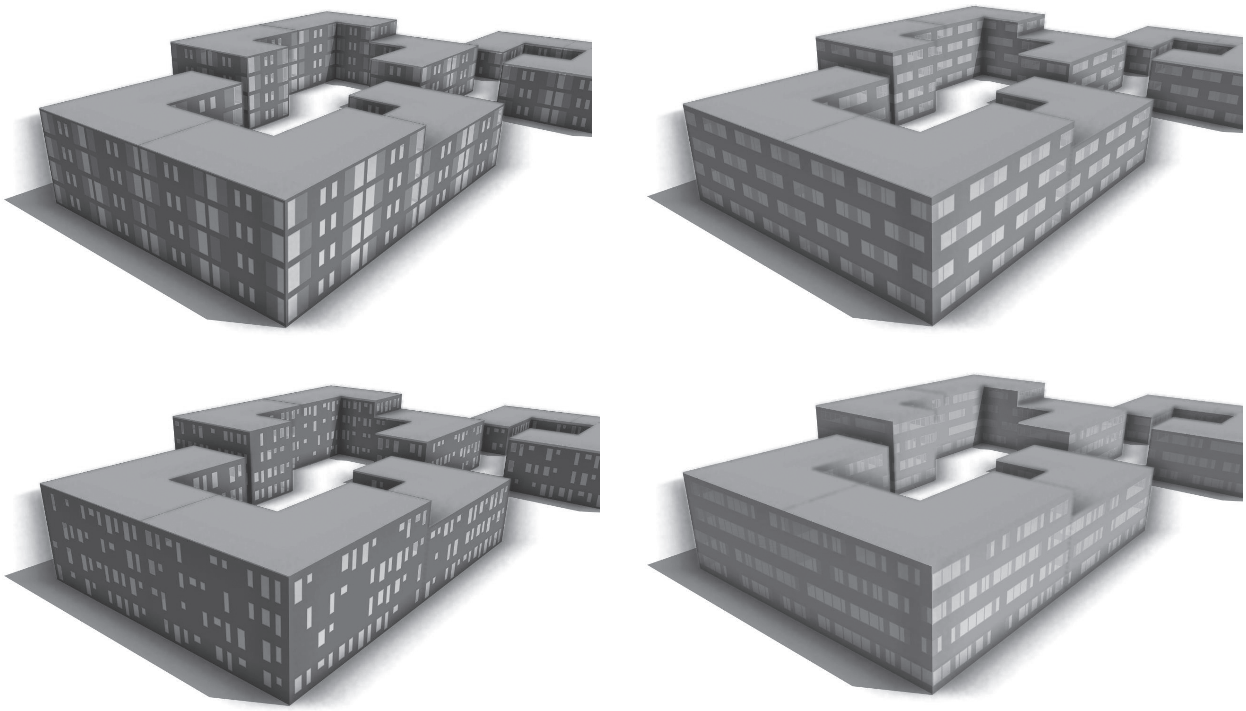

Fig. 3a-d. Examples of different facades on the same building envelope: a. Reflection pattern facade, b. glide reflection pattern facade, c. Repetitive random pattern facade, d. Random pattern façade; by authors

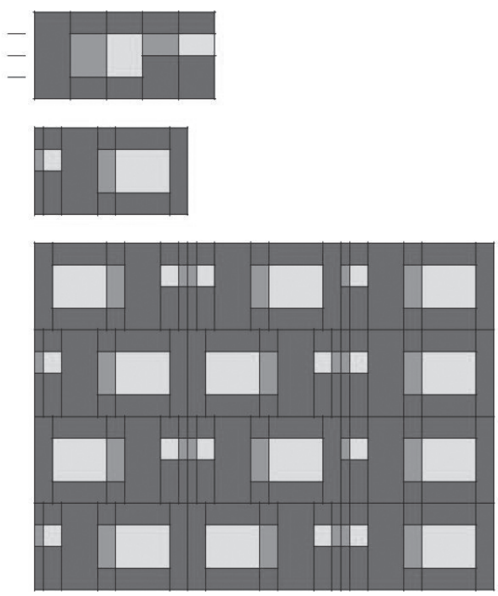

Fig. 4a-c. Structural logic for facade schemas: a. Generic facade elements with vertical splits, b. Set of horizontally scaled facade elements, c. Facade composed from the same set repeated in different combinations of reflection, glide reflection and translation; by authors

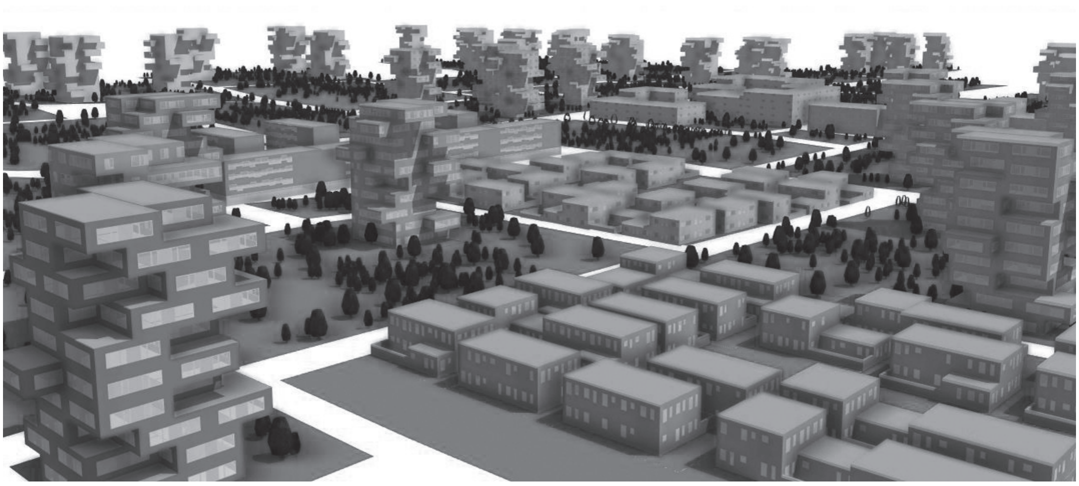

Fig. 5. Example of an urban environment generated from the elements described above; by authors

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ARCHITEKTURY PIĘKNO CZY DOBRO, CZYLI CZYM ARCHITEKTURA JEST I CO ZNACZY?

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ARCHITECTURE: BEAUTY OR GOOD? OR WHAT ARCHITECTURE IS IN SEMANTIC ASPECT?

Abstract
In reference to the principles of the semantics associated with the phenomenon of architecture and derived its terms, and to Vitruvian triad venustas, utilitas, firmitas, this discussion focuses on the concepts of beauty and good in the context of the theory and the realities of their key modernist motifs, as elitism – egalitarianism, everyday life and celebrating art and especially architecture, and beyond, touching on the issue of order and chaos, as well as the topic: art-kitsch-religion.

Streszczenie
W nawiązaniu do pryncypiów semantyki języka, związanej z fenomenem architektury i pochodnych od niej terminów, a także do witruwiańskiej triady venustas, utilitas, firmitas, niniejsze rozważania koncentrują się na pojęciach piękna i dobra w kontekście teorii i realiów modernistycznych z ich kluczowymi wątkami, jak elitaryzm-egalitaryzm, codzienność i odświętność sztuki, szczególnie architektury, i dalej, zahaczając o problem ładu i chaosu, nawiązują także do wątku: sztuka-kicz-religia.

Keywords: architecture; elitism; egalitarianism; beauty; good; order; chaos; harmony

Słowa kluczowe: architektura; elitaryzm; egalitaryzm; piękno; dobro; hiperład; ład harmonijny; chaos

Architektura powinna mieć dość pewności
siebie, a także uprzejmości,
by pozwolić sobie na odrobinę nudy[…]
w architekturze nic nie jest brzydkie samo
w sobie – coś może być […]
na niewłaściwym miejscu lub po niewłaściwej
stronie, ponieważ piękno
jest dzieckiem harmonijnych relacji między
częściami [1] *.*

W mojej długiej historii zainteresowania architekturą i związanymi z nią działaniami, które w praktyce rozwijały warsztat architektoniczny, po dobrych dwudziestu latach zaangażowania w dydaktykę i w konsekwencji tego – w tejże architektury teorię, mój stosunek do istoty fenomenu, a także do sensu zawodu architekta ulegał zmianom. W gruncie rzeczy zjawisko takie nie jest niczym niezwykłym, jest zrozumiałe: z czasem, jeśli poważnie traktujemy to, co robimy, oczywisty zda się rozwój naszej osobowości, a tym samym podatność na zmiany. Powinniśmy wiedzieć coraz więcej i działać coraz to lepiej, biorąc jednocześnie pod uwagę, iż często kilkadziesiąt lat obcowania ze zjawiskiem, zwłaszcza w wieku XX i dalej, oznacza konieczność permanentnej i coraz to bardziej wnikliwej weryfikacji stanu, w jakim znajduje się świat, w którym żyjemy, i ciągłego przystosowywania się do nieprawdopodobnie szybko następujących zmian, charakteryzujących się ciągłym przyspieszeniem we wszystkich dziedzinach naszego życia. Uwzględnienia wymaga zwłaszcza fakt, że architektura należy do niewielkiej grupy dyscyplin o szczególnie szerokim zakresie obecności i funkcjonowania.

W rozważaniach tych chodzi jednak o coś nieco innego. Nie zamierzają zajmować się one oczywistościami jak powyższe, per se, lecz zmiennością w interpretacji zjawisk w czasie, i to nie tylko w sensie wyłącznie liniowym: od gorzej do lepiej, w zgodzie z zasadami tzw. rozwoju i wzrostu, lecz w sensie falowania: nieustających poszukiwań. Także, a może szczególnie, chodzi o nieprawidłowości w myśleniu i działaniu, zaistniałe w konsekwencji rozlicznych mitów i zakłamań. Te główne nurty dotyczące sfery pojęciowej i semantycznej fenomenu architektury nie dają się, z zasady, w praktyce perfekcyjnie rozdzielić; wiążą się i nakładają na siebie. Nie chodzi tu wszak o precyzyjne, naukowe szufladkowanie, warto natomiast, koncentrując się na pojęciu tytułowym, zastanowić się nad aspektami o szczególnie nośnym dla architektury charakterze.

Zda się logiczne, że w tak rozległej problematyce nieuchronne są powroty do wcześniej poruszanych wątków. Pojawiające się powtórzenia tłumaczą się różnorodnością kontekstów rozmaitych problemów - obecnych w różnych moich tekstach - ale też i potrzebą porządkowania przemyśleń z punku widzenia aktualnie omawianego hasła. Jakkolwiek nie zamierzam niniejszych rozważań rozpoczynać od pryncypiów, po kolei, czyli ab ovo, choć wypada, by to jajo – pojęcie: czym jest architektura, jednak na wejściu, tak jak je widzę, zaistniało.

Porównując różnorakie dyscypliny i adekwatne do nich profesje czy zajęcia, związane, powiedzmy z dziedziną sztuki jak muzyka, poezja czy malarstwo, ze zdecydowanie wąskokątnym spectrum postrzegania, choć także z dyscyplinami innych sfer, jak medycyna czy też edukacja z zawodem nauczyciela i pedagoga, znacznie bardziej szerokokątnymi - z nimi nie ma raczej, jak sądzę, problemu, gdy chodzi o zrozumienie, co pojęcia te znaczą. Z architekturą, w stosunku do innych dyscyplin sztuki, ale także i techniki, jest całkiem inaczej. Jako że, z jednej strony, mieści w sobie, stosownie do rozmaitego jej postrzegania i różnych sposobów kwalifikacji, pojęcia różne, trudna jest ona do jednoznacznego umiejscowienia w semantyce języka dla znacznej części zainteresowanych nią, biernie lub czynnie, specjalistów czy miłośników-dyletantów (laików na razie zostawmy); z drugiej strony – dla chyba znacznie mniejszej ich części jest w ocenie jednoznaczna – przy skrajnie ograniczonym, wprost najprostszym zakresie pojęcia. Ale też wieloznaczność pojęcia nie musi deprymować. Nasz język ze swymi słownikami przyzwyczaił nas do faktu, iż to samo słowo może znaczeń różnych mieć wiele.

Zatem - architektura. Spróbujmy po raz kolejny powrócić do pryncypiów, zastanawiając się, cóż pojęcie to znaczy, czym ona jest. Myślę, że należy zacząć od dwóch jej definicji. Jest ich z pewnością znacznie więcej, jawią się one jednak, z zasady, jako uzupełnienia dwóch tych kluczowych, czasami jako piękne, niekiedy wymyślne i spektakularne ozdobniki, tworzone jakby około przewodnich myśli dotyczących pojęcia „architektura".

Te dwa określenia można uznać jako podstawowe: pierwsze – osadzone w kontekście przestrzennym i materialnym, fizykalnym, drugie wynika z kontekstu semantycznego, językowego, etymologicznego. Nie mam kompetencji ani też i ambicji tworzenia pojęć słownikowych, w tym miejscu chodzi o sens i logikę określeń, bez odwołań do słownikowych autorytetów. Celem jest próba porządkowania i poprawiania ad hoc zagmatwanego stanu pojęciowego, oddziałującego negatywnie na przestrzeń, w której żyjemy, z myślą u nauczaniu i uczeniu się architektury - wartości jako priorytetu. Polska, jako kraj, który głównie powinien nas tu absorbować, jest tego stanu, chaosu przestrzeni, klinicznym przykładem. I nie wynika to z braku jednoznaczności w konsekwencji dyskutowanej wielości koncepcji traktowania fenomenu, lecz z całkowitego braku nim zainteresowania i, co z tego wynika, z kompletnej nieznajomości problemu.

Sens pierwszej definicji mógłby brzmieć tak: Architektura to cała przestrzeń materialna, fizykalna, w której człowiek żyje, przez niego budowana i organizowana. Jakkolwiek to budynek przede wszystkim utożsamiany jest z architekturą (mamy jeszcze budowlę, do niej powrócę), nie powstaje on jednak w próżni, posiada swe otoczenie. Przez całościowość architektury należy więc rozumieć materię wraz z otaczającą ją przestrzenią, dającą oddech, powietrze pomiędzy „materiami". Zespół budynków (i budowli), osiedle, a nie poszczególne obiekty in se, są architekturą jako całością, czyli budynkami z tym, co się dzieje między nimi łącznie z pustką, powietrzem, pod warunkiem, że intencją jest tworzenie ładu i harmonii, i że nie mamy do czynienia z zastaną anarchią przestrzenną, chaosem, wyobrażającą często nieprawdopodobnie negatywne formy. Całościowość architektury ma jeszcze jedno

[1] A. de Botton, Architektura szczęścia, Czuły Barbarzyńca Press, Warszawa 2010, s. 186, 216.

znaczenie. Ta cała przestrzeń (powtórzmy) to nie wybrane domy, budynki, obiekty, te ładne i ważne, honorowane architektoniczne hity. Ważnym, choć niekoniecznie pięknym (czy nawet, lepiej: ładnym), z założenia jest każde ludzkie schronienie, udane czy nieudane. W tym miejscu warto przywołać słynne, a i oklepane powiedzenie Rema Koolhaasa: fuck context, w którym daje on wyraz dystansowania się od nieakceptowanego otoczenia, odcinania się od niego, robiąc swoje. Rozumiejąc go, sądzę jednak, iż udawanie, że nie zauważa się negatywnego stanu problemu, sprawy nie rozwiązuje i że istnieją inne postawy reagowania na zjawisko. To jednak temat sam w sobie, na inną okazję.

Sens definicji drugiej tkwi w semantyce słowa składającego się z dwóch równie ważnych pojęć: archi i tektura. Tektura to osłona, otulina naszego życiowego sacrum. Pomijając w tym miejscu Greków, słowo w tym jego rozumieniu pochodzi z łaciny - tectum to wprost: strzecha, dom, mieszkanie, świątynia, grota, jaskinia, a tectus to kryty, nakryty, opatrzony dachem[2]. Tektura natomiast to przecież gruby rodzaj papieru służący między innymi do wykonania pudła, dla osłony czegoś cennego, zawartości zasługującej na ochronę. Podczas gdy kwintesencją otaczającej nas przestrzeni jest dom, budynek, to sensem domu, budynku jest jego wnętrze; jest więc on czymś wydrążonym, w przeciwieństwie do budowli, pełnej, która wydrążoną nie jest, z zasady. Dom zatem to struktura osłonięta, zamknięta, z opakowaną (tak!) jego przestrzenią wewnętrzną. A archi? Od źródłosłowu – pnia, jakim jest słowo: arch (arc) i wszelkie jego pochodne, jak archi czy arche znaczą coś ważnego, nadrzędnego, prawiecznego, a także i łączącego, wiążącego. Mamy więc raz budynek, bryłę wydrążoną, posiadającą wnętrze; raz budowlę, z zasady niewydrążoną, wnętrza nieposiadającą, jak miedzy innymi pomnik czy most. To właśnie most, od zarania łuk, arc (franc.), łączy dwa niedostępne sobie brzegi. Sens łuku tkwi w jego zworniku, w nim łuku doskonałość. I architektura, in se, łączy. Miasto budowano, by ludzi łączyło.

* * *

W pisaniu o architekturze, w dyskusjach na jej temat, ale głównie może w wykładach dla studentów architektury (choć w zależności od tego, kto i co im wykłada :-), do znudzenia powtarza się nieustająco, wplatając w różne konteksty prawdę witruwiańskiej triady: venustas, utilitas, firmitas. To uprawnione, w porządku: trudno i niekomfortowo majstrować przy niepodważalnej prawdzie naszego wielkiego antenata, przyjmując ją w jej podstawowym przesłaniu za dobrą monetę. Przez stulecia do triady tej nie sposób było coś dodać czy ująć. Należy jednak pamiętać, że nie stoimy w miejscu i choć niekoniecznie musimy negować dokonania poprzedników, powinniśmy przyglądać się im i stosownie do upływu czasu, a zatem do nieustannej zmiany warunków, uzupełniać nawet pozornie niepodważalne prawdy.

W warunkach ułatwionych, dzięki Witruwiuszowi, zajmujący się teorią architektury badacze, ci niepokorni, którzy wątpią (dubito), gdyż wiara w utrwalone już prawdy im nie wystarcza, całkiem już nie potrafią, nawet chlubnie, pasożytować na mistrzu. W moich tekstach wielokrotnie na niego się powołując, co jakiś czas do niego wracając, zatrzymuję się i kolejny raz staram się weryfikować mój pogląd. Nic to odkrywczego, tego rodzaju zabieg winno się chyba, wszak, stosować z zasady. Zacznijmy od firmitas, czyli trwałości, w polskiej interpretacji sfery konstrukcyjnej architektury. Zaakceptowaliśmy wszak koncepcję wielkiego Rzymianina i oczywiście, mówiąc o trwałości, chodzi tu głównie i przede wszystkim o materię. Jednak chyba warto poszerzyć sprawę o trwałość duchową, różnych zresztą kontekstów (symbolika miejsca, pamięć, rola znaku, miejsce w percepcji architektury itp.). W jednym z esejów mojej książki poruszyłem ten problem[3], nie jest więc zasadne wracać do sprawy w tym miejscu; uzupełnienie czegoś o coś to jeszcze niekoniecznie zamiana czegoś na inne.

Zgodnie z przyjętym tytułem niniejszego szkicu warto natomiast zająć się dwoma następnymi pojęciami triady: venustas, czyli pięknem, podległym sferze sztuki, i utilitas, czyli dobrem, podległym sferze wiedzy o człowieku, w jakiej mieści się funkcja architektoniczna – użyteczność.

Wbrew pozorom, a ściślej – wbrew zakodowanemu w nas przeświadczeniu, piękno i użyteczność architektury nie mają z gruntu odrębnych, przeciwstawnych sobie czy wręcz antagonistycznych wartości. Nie bagatelizowałbym, już na wejściu, obiegowej oceny, często występującej u samych architektów przy okazji oceny jakiegoś obiektu w rodzaju stwierdzeń typu: dobra architektura, w przypadku zwrócenia uwagi na walory estetyczne jego formy, a niekoniecznie funkcji, czyli na wartości artystyczne, a nie wyłącznie użytkowe. Dziewczyna, którą na pierwszy rzut oka uznamy za piękną, może się przestać podobać, jeśli stwierdzimy

[2] Słownik łacińsko-polski, opr. K. Kumaniecki, PWN, Warszawa 1984.
[3] J.A. Włodarczyk, Obecność architektury, Rozdz. 3: O trwałości architektury, Wyższa Szkoła Techniczna, Katowice 2013.
[4] J.A. Włodarczyk, op. cit., Rozdz. 2: O odświętności i codzienności architektury, Wyższa Szkoła Techniczna, Katowice 2013.

u niej cechy negatywne; czasem wystarczy, by tylko otworzyła buzię :-), i odwrotnie: dziewczyna może nie wyjątkowej urody, będzie się nam podobać coraz bardziej, kiedy to, poznając ją bliżej, zauważymy szczególnie pozytywne walory jej charakteru; wyda nam się znacznie ładniejsza niż przy jej poznaniu. Uśmiech, niemal z zasady, może nas uczynić piękniejszymi, choć nasza fizjonomia obiektywnie zmianie nie ulega. Są to sygnały, iż pojęcia piękna i dobra mogą się niekiedy na siebie nakładać. Estetyka i etyka, razem. Skoro niekiedy przekłada się cechy ludzkie na architekturę, można by oczekiwać od niej swoistego wyrazu z czymś na kształt uśmiechu włącznie; jednak, choć postmoderniści czegoś takiego próbowali i wychodziły z tego grymasy, skrzywienia wątpliwej proweniencji :-(, zostawmy.

Można uważać, że zjawisko to wiązało się z kontekstem rozważań nad pojęciem piękna w sztuce i tym, iż sztuka wcale piękna być nie musi, i że dwa te pojęcia, te dwie wartości nie są nierozdzielne. W wyniku poszukiwań właściwej dla architektury, szeroko rozumianej drogi w próbach oderwania się wreszcie od tradycji antyku i w konsekwencji sukcesywnie narastających ich nawarstwień na przełomie XIX i XX wieku uzyskano wreszcie maksymalne tego efekty w 2-3 dekadzie nowego stulecia. Jednocześnie uporządkowano w miarę problem miejsca architektury w sztuce. Z wynaturzeniami – w postaci: czy to wcześniej w wyniku wszelkich eklektycznych działań jako rezultatu zniewolenia jeszcze antykiem, czy już swobodniej, w czasie od niego się odrywania, czyli secesji – uporała się wreszcie z tym wszystkim nowoczesność. Zda się więc, iż zbitka pojęć: architektura i sztuka, plus modernizm i ich wzajemne, nowe zależności musiały całkiem przekształcić nasze postrzeganie sztuki.

Schyłek epoki, zwany fin de siècle'm, naznaczony rolą odegraną przez paryską Ecole des Beaux-Arts, ocenić można jako najgorszy okres dla architektury, swego rodzaju jej rozbiór. Rola jej ograniczona została do elementu artystycznego, czyli formy, ale ograniczonej do ozdoby, decorum, mniej czy więcej potrzebnego appendixu, dodatku przyklejonego do funkcji i konstrukcji wartości zawłaszczonych zresztą przez techników, humanistów i innych tutti quanti. Architektowi został okrojony zakres formy, ta pseudoforma. W modernizmie, po raz pierwszy od czasów gotyku, piękno architektury, a z pewnością lepiej - jej forma, mogły być wyrażane dzięki strukturze, a nie doklejanemu na siłę ornamentowi. Nie znaczy to, że wciąż resztki tego pawiego ogona tu i tam nie ciągną się jeszcze za nami, ale to już problem inny, kolejny. Tak czy inaczej, można więc chyba zgodzić się, iż wszystko to jest wystarczającym argumentem, by termin: d o b r a architektura, w miejsce: p i ę k n a - w określonych konsytuacjach - zaakceptować.

Tak: to, czego dotyczą powyższe refleksje, to sfera architektury uniwersalnej, europejskiej, naszej antyczno-chrześcijańskiej tradycji. Ale jest także tego zagadnienia jakby druga strona: tradycja rodzima, ludowa, regionalna. Nasza własna. Wiejska (pozytywna lub obojętna) bądź wsiowa (negatywna); zasiedziała, nieprzewietrzana i nieweryfikowana. Dominująca w konsekwencji dominującej wiejskości nad miejskością kraju, a także dominującej religii katolickiej, akcentowanej obrazem i spektaklem, czyli wizualną formą przekazu wartości religijnych. Czynniki te, obok selekcjonowanych przez elity wartościowych obiektów sztuki ludowej, musiały zawsze owocować kiczem; jakże często do rangi sztuki kicz usiłując podciągnąć, albo też i do poziomu kiczu ją ściągając.

Mówiąc o wpływie myślenia o sztuce na naszą polską przestrzeń poprzez wyznanie rzymskokatolickie z jego celebrą i tejże celebry wizualną oprawą, warto pamiętać o wpływach innych krajów katolickich, głównie Włoch – ostatecznie, wraz z chrześcijaństwem wszystko przychodziło do nasz Zachodu. Włochy to naturalne, bez komentarza: Rzym, Watykan, papież, etc. Architektura europejska od czasów reformacji, jako zjawisko przez kontrreformację utrwalone, zaznaczyła się zdecydowanym podziałem w zakresie formy: uporządkowanej, wstrzemięźliwej i oszczędnej w wyrazie w krajach protestanckich - Anglii, Holandii, północnych Niemczech, Skandynawii i, ze wszystkimi przeciwnymi cechami wyżej wymienionych, w krajach katolickich: Hiszpanii, Portugalii, we Włoszech, i w Polsce - z uwzględnieniem różnic jakościowych przestrzeni, oczywiście. Z punktu widzenia: miejskość-wiejskość, zestawienie jest trudno porównywalne. Nie darmo szczytowe osiągnięcia wchodzącego właśnie na europejską scenę modernizmu mają miejsce w Finlandii i Holandii, a i innych krajach niekatolickich, jak w Izraelu (Tel-Aviv), Związku Radzieckim lat dwudziestych, czy wreszcie w Czechach, kraju nibykatolickim, lecz o tradycjach husyckich, z wyraźnym od katolicyzmu odchodzeniem i wyraźną społeczeństwa laicyzacją. Im zresztą, Czechom, zdominowanym w czasach kontrreformacji przez katolicyzm, udało się przyswoić barok w jego najlepszej postaci. W Polsce, tradycyjnie już od wieków, na wartości estetyczne nakładają się wartości religijne. Stało się to swoistą zbitką pojęciową i tu barokowe sacrum trafiło pod strzechy, i wyszło, jak wyszło. Zda się to potwierdzeniem teorii percepcji sztuki w dychotomii: odświętne-codzienne, gdzie i sztuka, i religia występują razem, jako odświętne. Pojęcie sztuki innej niż sakralna, a więc codzienna, u przeważającej części naszego społeczeństwa nie zaistniało[4].

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Czyżby więc zmierzch piękna jako jednego z trzech pojęć witruwiańskiej triady? Niekoniecznie. To tylko kwestia charakteru i sensu tejże formy, a nie jej treści; do tego aspektu jeszcze powrócę. Problem jest aktualny tak długo, jak długo trwa modernizm i jak mantra wciąż wraca less is more i function first, a i tak wciąż trzeba tłumaczyć, że chodzi o inną formę i inne piękno niż o bezmyślnie dodawane decorum.

Czynnikami, jakie niewątpliwie miały istotny wpływ na estetykę modernizmu w architekturze, były typizacja i prefabrykacja. Oba one to konsekwencja przeciwstawienia elitarności egalitarności. Zjawiska typizacji modernizm nie wymyślił, traktował ją jako conditio sine qua non, zakładał jednak określony jej zakres i skalę. Ją wcześniej, z czasem, w konsekwencji rozwoju techniki, prefabrykację, z takim też warunkiem jak i typizację. Powtarzalność projektów, w całości lub w części, jako powielanie wzorca, znamy już z antyku, od Greków wziętą. Świątynia. W naszym kraju, w Królestwie Polskim (1815-1830), przykładem rodzącego się przemysłu, np. tkackiego, są realizacje według projektów typowych domów tkaczy, w Łodzi czy Pabianicach, gdzieniegdzie zachowane. Sięgnijmy jeszcze bliżej, w drugą połowę wieku XIX, czas najczęściej i najchętniej przeciwstawiany modernizmowi, jako reprezentujący architekturę atrakcyjną w przeciwieństwie do monotonii i nudy nowoczesności. Przyjrzyjmy się czynszowej mieszkaniówce, wejdźmy do mieszkań, poodwiedzajmy je po kolei. I co zobaczymy? Identyczne mieszkania, jak leci: i te duże, komfortowe od ulicy, i małe, niekomfortowe od podwórza. Identyczne, więc dla odróżnienia, a i dla piękna obklejano fasady ornamentem, od-sasa-do-lasa, oczywiście te od ulicy, od przodu, aby stały się widoczne i by się nimi pochwalić, aby je odróżnić od siebie, lecz od tyłu już nie. Piękno architektury tkwiło więc w ornamencie, czynniku abstrakcyjnym, z bryłą budynku niezintegrowanym, skoro taki sam budynek można było byle jakim decorum uszczęśliwić. A skoro tak, to faktycznie, może i trudno się dziwić, że we wspomnianym wyżej niechlubnym dla architektury czasie rolę architekta postrzegano jako dekoratora, skoro ani użytkowość (powielana), ani koncepcja konstrukcyjna (powielana podobnie) nie interesowały go – takie były wszak trendy: tak silnie przywarło do nas naznaczenie antykiem, cóż, że podrabianym.

Tak, lubimy wszystko, co-się-da, ozdobić, nie tylko architekturę, tę od wielkiego dzwonu, ale i w życiu, na co dzień, zagracając wnętrza i zewnętrza naszego otoczenia, czy wręcz się ubierając, rozmaite dziwne rzeczy nakładając na siebie. Taki drobiazg, już z zasady, z przyzwyczajenia: choinka, piękne drzewko bożonarodzeniowe, zwłaszcza gdy sosnowe, obwieszone zwykle tak pięknymi ozdobami, że może często przydałoby się je, ozdoby, czymś dla ozdoby osłonić :-). Czyż sama natura, wciągnięta w przestrzeń kultury celem jej upiększenia, powiedzmy - z dyskretnym oświetleniem jednobarwnych lampek, nie wystarczy, nie jest wystarczająco piękna? Bywa różnie, w znacznej mierze decyduje tu tradycja i przyzwyczajenie, ostatecznie we własnym domu – wolnoć Tomku. Ale też mówi się: to ze względu na dzieci, one to lubią. Nieprawda, to dorośli lubią tak mieć, dzieci zwykle wiele do powiedzenia nie mają, choć często mają znakomite wyczucie formy. Obserwowałem dziecięce rysunki i tak gdzieś do siódmego roku życia potrafią świetnie rysować – dopóki dorośli, głównie szkoła, skutecznie im w tym nie zaczną przeszkadzać!

Dobrze. Estetyka: pięknie-niepięknie, ważna rzecz. Architektura jednak, jako sztuka, to nie malarstwo czy inny nieużytkowy jej rodzaj; obraz można sobie w domu zawiesić - fajnie, lubię malarstwo, mam swych ulubionych mistrzów, choć nie o nich koniecznie chodzi - ale nie jest to niezbędne. Od dawna (choć nie zawsze, tafelbild to zjawisko zaistniałe dopiero od średniowiecza) tak było i dalej tak jest, w porządku. Tu nic nie drgnęło. Z architekturą - inaczej. Obrotu o 180°, czyli wejścia egalitaryzmu w miejsce elitaryzmu (no, nie do końca, non omnis, na szczęście :-)), nie wymyślono ot, tak sobie. Stabilność zaludnienia świata (zostańmy przy Europie) długo utrzymywała się na w miarę przewidywalnym poziomie, czemu sprzyjały wojny i rewolucje, epidemie, głównie niedostateczna wiedza i wielce ograniczone tym samym możliwości utrzymywania człowieka przy życiu, czyli wczesna umieralność. Dla elity miejsca i innych środków starczało, o nieelitę, czyli masy (bardziej elegancko: naród, społeczeństwo) nie troszczono się.

Przełom wieków XIX i XX zaznaczył się gwałtownym, z dziesięciolecia na dziesięciolecie, permanentnym przyspieszaniem wzrostu ludności, jednocześnie i rozwojem wiedzy wszelkich dziedzin, z ich teorią i praktyką. Wzrost zaludnienia, głównie miast, rozwój przemysłu, powodowały gwałtowny wzrost zatrudnienia i niespotykaną dotąd potrzebę budowy mieszkań dla niespotykanej liczby robotników, rekrutujących się głównie ze wsi. Równolegle dokonywał się także przełom w myśleniu społecznym, choć wszelkie teorie uzdrawiania stosunków społecznych i warunków życia nieelity elity nie absorbowały. Nawiasem mówiąc, kapitalizm był zainteresowany godziwymi w miarę warunkami siły roboczej, a idee humanistyczne musiały z czasem, nolens-volens, znaleźć aplauz na w miarę znacznym poziomie - przynajmniej teoretycznie czy pozornie. No i przebrnąwszy przez te parę truizmów (wszystko to bowiem niby każdy z nas wie!?), mamy podstawy do zrozumienia logiki egalitaryzmu, czyli sposobu na architekturę nowoczesną.

Modernizm architektury to niewątpliwie przede wszystkim idee egalitaryzmu: na dobre i na złe. Wszyscyśmy równi, jakkolwiek nasze mózgi, jeśli nawet jednakowe, to niejednakowo chyba wykorzystywane :-). Oczywiście, wypada wprost mówić o dobru; etyka, moralność zobowiązuje nas do tego, rzecz jest jakby pozadyskusyjna. Sprawiedliwość, równość wobec prawa: tak nam mówi nasza chrześcijańska religia, ale i wypisane było to też na sztandarach Rewolucji Francuskiej, a z pewnością propagowana przez nią równość. Jakże często, a może jest to i regułą, chcemy równości, to oczywiste. Jednak gdy już ją osiągniemy (choć jak to ocenić i sprawdzić?), chcemy być lepsi, mieć więcej niż inni. W miejsce slumsowych warunków uzyskujemy prawie darmo, jak w naszym PRL-u, mieszkanie w miejskiej, (modernistycznej) zabudowie wielorodzinnej, z mieszkaniem M4 czy M5, z podstawowym komfortem. Krótko po tym brzydzi nas blokowisko, chcemy mieć domek z ogródkiem. A dalej nawet mieszkanie w domu wielorodzinnym, ale już grodzonym, ze strażnikiem, sygnalizacją i psem. Albo ewentualnie w tradycyjnej zabudowie, w kamienicy, ale w mieszkaniu tym od ulicy, nie slumsowym, podwórkowym. Bez komentarza. Zrozumiałe w przypadku zwykłego, przeciętnego użytkownika architektury: chcę mieć więcej, ale też i być lepszy od drugiego, by móc mu imponować; niezrozumiałe w ustach jej teoretyków, opozycyjnych w stosunku do idei modernizmu, że wspomnę przykładowo, Leona Kriera [5].

W architekturze modernistycznej, głównie mieszkaniowej, chodzi - czy nam się to podoba, czy nie - o masówkę, o substancje większej znacznie skali w stosunku do architektury elitarnej. Tu musimy przyjmować inne kryteria oceny fenomenu, jakim jest z natury rzeczy architektura egalitarna. Pojęcia: piękne-brzydkie nabierają tu innych znaczeń. Za architekturę elitarną uważano tę najlepszą. Egalitarną jest każda, lepsza czy gorsza, bez znaczenia.

Rzecz w tym, iż w dyskusjach, zresztą, na-jakibądź-temat: ładne-brzydkie, dobre-złe itd. popełniamy dwa błędy, dwie nieprawidłowości, jakbyśmy tego nie nazwali. Pierwsze to wpadanie w skrajności: albo jest coś takie, albo siakie, myślenie czarno-białe, w środku nic, zero. Drugie to porównywanie nieporównywalnego. Zwykle dotyczy to porównań czynionych w sposób niesymetryczny: z tego, co faworyzujemy, bierzemy przykłady najlepsze, z tego, co odrzucamy – przykłady najgorsze. Tak jest w przypadku porównań architektury tradycyjnej, powiedzmy, że powrócę: XIX-wiecznej kamienicy czynszowej z modernistycznym tzw. blokiem. Przykładem pozytywnym będzie wtedy luksusowa kamienica XVI dzielnicy Paryża, no, może też i ta bogatsza z przedwojennej warszawskiej ulicy Marszałkowskiej, a negatywnym - źle wykonany budynek z wielkiej płyty, z jakiejś Pipidówki Wielkiej, w Polsce, na Ukrainie, w Rosji czy z innego kraju środkowo-wschodniej Europy (choć i na zachodzie Europy też by się coś takiego znalazło). Dla tych budynków wymyślono u nas piękne określenie: blokowisko (tak jakby: ludzie, czyli ludziska).

Sądzę, iż można by zaryzykować twierdzenie, z którego wynika, że porównując jakość porównywalnej, tej mniej niż przeciętnej substancji mieszkaniowej XIX-wiecznej zabudowy kwartałowej z odpowiednią modernistyczną, ocena wypadłaby na korzyść tej drugiej - tak w Polsce, jak i z pewnością w architekturze Zachodu, głównie jego krajów zachodnich i północnych, jakkolwiek zależałoby to niewątpliwie od obrazu stopnia zniszczenia miast w czasie II wojny światowej. W przypadku Polski dotyczyłoby to zarówno osiągnięć w międzywojniu, jak i w PRL-u. Sprawdzenie tej sugestii to już zadanie dla naszych badaczy.

Ilość jest wrogiem jakości, to wiemy. Wszelkie porównania elitaryzmu architektury tradycyjnej wywodzącej się z kultury antycznej przyswojonej przez chrześcijaństwo z egalitaryzmem nowoczesności wypadają niekorzystnie dla wartości drugiej; są z natury rzeczy nieadekwatne, więc bezzasadne. Inne konteksty, inne: czas, skala, mentalność. Z jednej strony stulecie modernizmu, z drugiej – kilka tysiącleci wspomnianej tradycji. Warto pamiętać, że obraz ten wzmocniły kolosalne zniszczenia II wojny, powodując dodatkowe przyspieszenie w odtwarzaniu i zwiększaniu substancji budowlanej Europy, niezależnie od czynników związanych z oczywistym wzrostem i rozwojem, zaznaczonym wyżej.

Nadmiar powoduje nudę. Im czegoś więcej, nudzi nas tym bardziej, i to bez względu na to, czy odbieramy to jako złe, czy jako dobre, negatywne czy pozytywne; nadmiar czegoś fajnego też znudzić potrafi, można by przywołać tu i doświadczenia kulinarne. Jednak jakość tak rozumianego pojęcia nudy nie jest, oczywiście, bez znaczenia. Można sądzić, że powszechnym zjawiskiem jest u ludzi potrzeba atrakcyjności w dzianiu się, w spektakularności. Mam prawo sądzić, że czytanie Prousta czy słuchanie kwartetów Haydna uważane będzie, przez większość odbiorców

[5] L. Krier, Architektura. Wybór czy przeznaczenie, Arkady, Warszawa 2001, s. 13, 82.

za nudne; u mnie jest – odwrotnie; rządzi nami subiektywizm. Nudne, gdyż zbyt wolno sprawy się toczą. W porządku, to jeszcze nie musi mieć naznaczenia: dobre/złe. Jednak preferencja nadmierna tego dziania się w przestrzeni zorganizowanej powoduje często zbytnią dowolność, prowadzącą do chaosu, do anarchii przestrzennej. Wiemy, iż w naszym społeczeństwie jawi się to jako swoista cecha, narodowa, sięgająca wspólnoty plemiennej. Mieszkalnictwo jednorodzinne jest tego klinicznym przykładem. I obojętny jest tu fakt, czy mamy do czynienia z chaosem interesujących, ładnych budynków z ich otoczeniem, czy z czymś przeciwnym. Chaos pozostaje chaosem.

Jako przeciwieństwo chaosu widzę nie tyle pojęcie ładu pozytywnego, nazywanego harmonijnym, lecz ładu jakby na kształt niemieckiego ordnung, czyli oscylującego w stronę hiperładu, ładu odbieranego negatywnie: nadmiernego, niezharmonizowanego, psychicznie uciążliwego i niewątpliwie - nudnego. Jak zwykle sens w takich razach tkwi w środku, nie na obrzeżach i jest rodzajem kompromisu, którym jest właśnie stan harmonii. Zjawiska nie należy oceniać jako od negatywnego (chaos) do pozytywnego (ład), lecz na zasadzie łuku, gdzie wartości negatywne (chaos i hiperład) znajdują się w przyczółkach, a to, co pozytywne, jest w środku, w zworniku (ład harmonijny)[6]. Analogii z zasadą łuku można by się dopatrzeć, między innymi w najnowszej (?) historii polityki: skrajności prawicy (nacjonalizm, faszyzm) i lewicy (komunistyczny totalitaryzm) często znacznie łatwiej do siebie przystają niż każde z nich z osobna do kompromisowego środka, czyli demokracji i liberalizmu.

„ […] Robert Brasillach, stracony po wyzwoleniu jako symbol kolaborującej [z Niemcami, przyp. JAW] inteligencji, a w latach 30. pisujący […] skandaliczne teksty do gazet ekstremalnej prawicy, dawał często wyraz swemu […] podziwowi dla radykalnej lewicy […]. To w latach 20. Georges Valois […] próbował połączyć nacjonalizm i socjalizm w ruch zwalczający indywidualizm, liberalizm i ustrój parlamentarny[…]"[7].

Mamy tu jeszcze coś innego, jak bezład odbierany jako stan pozytywny, taki miły bałaganik, choć to już bardzo indywidualne traktowanie stanu naszego otoczenia. Jakże pasuje tu poetyckie ujęcie problemu, iż ład jest przyjemnością rozumu, ale bezład – rozkoszą wyobraźni" (P. Claudel).

Przeciwnicy rygorów jako konsekwencji ładu, każdego, a zwolennicy do-wolności, z hasłem: wszystko jest dozwolone, nie zauważają, iż w praktyce, w naszej rzeczywistości europejskiej, ale też i polskiej, obok negatywnych przykładów sfery tzw. blokowisk powstawało wiele dobrych (pięknych) zespołów architektury/urbanistyki, świetnie skomponowanych, w międzywojniu, w PRL-u, a i w ostatnim ćwierćwieczu: to nawet jest uzasadnione, w koncepcjach mieszkalnictwa poszliśmy zbyt często w kierunku niewłaściwym.

Większa wyliczanka byłaby w tym miejscu nonsensem, przywołam więc parę przykładów głównie warszawskich i tyskich, jak w międzywojniu osiedla B. S. Brukalskich Żoliborz, 1930-1934, H. i S. Syrkusów Rakowiec WSM, 1930-1937, a PRL-u tychże Syrkusów Praga I 1948-1952 oraz Koło ZOR 1950-1956, H. Skibniewskiej Sady Żoliborskie i Szwoleżerów 1972-1974 czy wreszcie Z. i O. Hansenów Przyczółek Grochowski, osiedle odsądzane od czci i wiary głównie w wyniku przekształceń projektu wbrew woli autorów, złej organizacji funkcjonowania osiedla przez jego administrację, też i w wyniku braku przygotowania użytkowników do zaakceptowania zbyt nowatorskich rozwiązań[8]. W Tychach już plan urbanistyczny miasta, realizowany zgodnie z jego założeniami, gwarantował wysoką jakość osiedli; wymienię z nich niektóre, według mnie tego warte, jak B, D3, E2 (szeregowo-galeriowe), E3, E4, K-Karolina i Z-Zuzanna. Wszystkie one, realizowane w różnym czasie od połowy lat pięćdziesiątych do połowy lat siedemdziesiątych, charakteryzują się dobrą kompozycją, zmierzającą do tworzenia związków przestrzennych i społecznych, a także w miarę dobrą czytelnością i wyrazistością[9]. Jeśli zaś chodzi o czasy nam najbliższe, czyli te po roku 1989, zaistniałe w wyniku powrotu po półwieczu do demokracji i kapitalizmu, ocena jest trudna. Trudność jej polega głównie na chaosie ideowym działań w przestrzeni, charakterystycznym dla ponowoczesności, w której to wszystko jest dozwolone, ale też w znacznej mierze ten zakres działań w bardzo małym stopniu absorbuje nasze społeczeństwo: od góry – władza, od dołu - użytkownik architektury. Na dole olbrzymi procent zainteresowanych problemem postrzega głównie to, co „moje": mieszkanie, dom, ale już w minimalnym stopniu bezpośrednie otoczenie będące poza własnym miejscem, czyli: moja chata z kraja. To, co w PRL-u sygnalizowało zaledwie jakieś oznaki

[6] J.A. Włodarczyk, Około architektury, Rozdz. 2: Między ładem a chaosem..., Politechnika Białostocka, Białystok 2003.
[7] T. Judt, Historia niedokończona. Francuscy intelektualiści 1944-1956, Wydawnictwo Krytyki Politycznej, Warszawa, s. 27-28.
[8] F. Springer, Zaczyn. O Zofii i Oskarze Hansenach, Wydawnictwo Karakter, Kraków 2013.
[9] J.A. Włodarczyk, Pokochać Tychy?, czyli Miasto od nowa, Wyższa Szkoła Techniczna, Katowice 2012.

wspólnot sąsiedzkich w naszym niespołecznym społeczeństwie, wyparowało. Nowe jednostki mieszkaniowe to zbiorowiska indywidualistów, bez możliwości kontaktów społecznych. Wszystko to ma swe korzenie w złym prawie, albo lepiej - w jego braku[10].

Oczywiście, zgodnie z teorią: ilość jest wrogiem jakości, potrzeby czasów międzywojnia, a w jeszcze większym stopniu czasu po II wojnie w Polsce, a co za tym idzie, masówka domów dla mas, stosownie do hasła egalitė sprawiały, że w określonych warunkach ekonomicznych, przykładów na złą lub taką sobie architekturę przytoczyć można by znacznie więcej. Samo życie. Dokładała się tu jeszcze często fascynacja nie zawsze sensowną powtarzalnością projektów u części architektów oraz wygodnictwa wykonawcy; ale na ten temat powiedziano już wiele.

Wracając jeszcze do zjawiska nudy w jej negatywnym aspekcie (nuda może być twórcza, a nawet przyjemna - do wielu powtarzających się permanentnie naszych działań nieustająco powracamy, z przyjemnością), wiele szkody poczyniło automatyczne powtarzanie układu grupy budynków, np. w tzw. układach grzebieniowych, ale i w każdej sytuacji, gdy liczba ich przekracza określoną wielkość, czyli o tendencji do liczby ograniczonej. Znane to zjawisko. W naszej skromnej literaturze z zakresu teorii architektury, w książce ponoć dobrze(?) znanej naszym architektom, pisał o tym Juliusz Żórawski: „Niektóre dzikie szczepy zdolne są liczyć zaledwie do sześciu; każdą większą ilość nazywają „dużo". Ludzie stojący na wysokim szczeblu cywilizacji umieją liczyć miliony, lecz potrafią spostrzec na raz i odróżnić najwyżej sześć elementów[11].

Więcej niż sześć powoduje dezorientację co do ilości, rozkojarzenie, zmęczenie i nudę. Tak jest i z naturą: jedno, dwa, trzy drzewa i dalej do sześciu są policzalne. Im bardziej w las, tym więcej drzew, coraz trudniej policzalnych. Tyle że drzewa nie nudzą, las zawsze jest piękny, a i nie ma potrzeby drzew liczenia.

Tak więc ład harmonijny z pewnością nudny być nie musi, nawet gdy jest w miarę uporządkowany, choć daleki od nadładu. A z drugiej strony - chaos może być nudny, także w wyniku powtórzeń. Powtarzalność w chaosie przedstawia bowiem inny zgoła charakter zbioru z uwagi na jedną i tę samą zasadę przy różnicy w szczegółach; nie jesteśmy w stanie odróżnić powtórzeń w ich w masie - często, jeśli nie powszechnie. Dla zjawiska przestrzennego chaosu nie ma też znaczenia, czy będzie on zbiorem budynków złych (brzydkich) czy dobrych (pięknych) lub jednych i drugich łącznie, przemieszanych. Nadmiar formy w układach nieuporządkowanych jest bowiem jednym z podstawowych wrogów architektury.

Wrogiem jej jest także dążenie do oryginalności z zasady, ta bowiem często może uzyskać status unikatu, ale już arcydzieła - baaardzo rzadko. Unikat może być dobry lub zły, arcydzieło zawsze dobre, o nie zresztą jest najtrudniej[12]. Architekt z zasady stara się być oryginalny. Zamiar taki nurtuje już studenta architektury od zarania styczności z tym zawodem uważa, że nosi w tornistrze buławę geniusza. Ileż to razy dawało mi się usłyszeć od studenta na korekcie, że chciałby zrobić projekt nie tyle dobry, lecz oryginalny. I tak to nam, architektom, zostaje. Ale geniuszem jest się rzadko, ale nawet, co-nie-daj-Boże, gdyby ich było w nadmiarze, nadmiar unikatów i arcydzieł – oryginalnych w swej masie powodowałby obraz otoczenia przerażający – obraz nadchaosu.

Dobra architektura, to architektura ładu harmonijnego, z powtórzeniami jako czynnikiem pozytywnym. Dobry architekt to profesjonalista perfekcyjny, a przy tym – humanista. Nie musi za każdym razem stawiać problemu na głowie, wystarczy, że coś tam doda do tego, co ktoś, a nawet on sam wcześniej już był powiedział. Liderzy to rzadkość, często geniusze, którzy z rozmaitych przyczyn nie mogli dopracować genialnych skądinąd pomysłów, nie wymyśla się też, z zasady, czegoś nie ulegającego potrzebie zmiany; ważniejsi są często kontynuatorzy, ważne, by byli dobrzy, coraz lepsi[13].

* * *

Przyjrzyjmy się miastom czasów gotyku i renesansu, najlepiej z lotu ptaka, no, z wieży czy z góry wierzchołka, zwykle z góry zamkowej, jeśli się taka w obrębie miasta nadarzyła. Zasadą jest obraz jednolitej w formie, w tym i w kolorze, tkanki mieszkaniowej z kilkoma, nielicznymi obiektami indywidualnymi kościoła (lub ich kilku) oraz ratusza. Substancja domów jednego koloru, materiału, jednej konwencji kształtowania architektury. Nikt nie miał odwagi czy w ogóle nie było to do pomyślenia, aby odejść od zasady, dającej zresztą znaczną swobodę komponowania domów. Tak było dawniej. Ale i dziś jest to możliwe i stosowane, zgodne też z ideami modernizmu, choć znacznie trudniejsze, przykłady jednak można by mnożyć. Na przeszkodzie

[10] K. Kaidanek, Suburbanizacja po polsku, Nomos, Kraków 2012.
[11] J. Żórawski, O budowie formy architektonicznej, Arkady, Warszawa 1962, s.27.
[12] J.A. Włodarczyk, Oblicza architektury, Rozdz. 5: Od unikatu do uniformu, Politechnika Białostocka, Białystok 2000.
[13] J.A. Włodarczyk, Drogi i ścieżki do architektury, Rozdz. VIII: Liderzy i kontynuatorzy. WST, Katowice 2010.

staje problem ilości, rosnącej nieustająco - i tak oto wracamy do problemu: elitaryzm-egalitaryzm.

Zakończmy rozważania inną parą pojęć, choć niekoniecznie antagonistycznych: piękno i dobro, od nich wszak rozważania rozpocząłem. Cóż więc z tym pięknem architektury, czyżbyśmy chcieli rezygnować z venustas? Nie, rzecz tkwi gdzie indziej, chodzi tu o problemy wynikające z różnic oddzielających architekturę od innych dyscyplin sztuki, głównie malarstwa. Jakkolwiek w teorii sztuki wiele się w ostatnich 100-150 latach zmieniło i „stało się oczywiste, że wszystko, co dotyczy sztuki, przestało być oczywiste […], nawet jej racja istnienia […]"[14], traktowanie jej może być odbierane powszechnie, z malarstwem głównie, jako sztuki kwintesencją, dominującym nad resztą jej, sztuki, dyscyplin. Architektura jest tu jakby na przeciwległym biegunie - przy tym iż większość dyscyplin mieści się w przestrzeni pomiędzy. Decyduje tu użytkowość architektury, ale nie tylko. Także masowość i egalitaryzm. Powie ktoś: obrazy w muzeach oglądają ludzie masowo; w porządku, ale to tak, jakby porównywać nieporównywalne, nieporównywalna jest bowiem skala potrzeb. Ale to także jeszcze nie wszystko. Oglądamy wyłącznie unikaty i arcydzieła, oglądamy od święta, no i w znacznej mierze dzięki wszędobylskiej reklamie, i że wypada. Tak jak na koncertach (muzyki klasycznej) słuchamy dzieł wybranych i uznanych. Oczywiście każdy artysta może zorganizować ekspozycje swojej, nie znanej jeszcze sztuki - tyle że oglądać/posłuchać pójdą tam krewni i znajomi królika. Znane i udostępnione ludziom dzieła sztuk zwanych pięknymi muszą być piękne z natury rzeczy, przeszły przez sito weryfikacji mędrców od piękna. Innych oni nie znają, inne więc nie istnieją. Otaczająca nas architektura oglądana na co dzień jest częścią naszego życia, piękna-niepiękna. Którą z niej nazwać piękną – oto jest pytanie. Stąd w jej przypadku lepiej posłużyć się w ocenie terminem: dobra, czyli użyteczna. Dla ciała i dla ducha. Może być formą piękną w swej użyteczności. Zda się bowiem, iż skończył się czas, w którym o pięknie decydowało decorum. Swoiste piękno architektury tkwi w jej strukturze, harmonii, kontrapunkcie, rytmach, fakturze i barwie. I tak chyba było i na początku, już u Greków. I jeszcze w gotyku. Liczyły się skala i proporcje. Decorum stopniowo zmieniało architekturę – niestety na gorsze.

Piękne, dobre. Słowa, słowa, słowa. A jednak słowo znaczy. Jak i architektura. Słów architektury, jak innych, zawsze i wszędzie, nie powinno się traktować w sposób ambiwalentny, na kształt przysłowia: jak się zwał, tak się zwał, byleby się dobrze miał. To niepoważne, bez sensu. Wiemy, że niewłaściwe użycie słów zawsze powoduje kłopoty. Ostatecznie - to, czym się różnimy od naszych młodszych braci, zwierząt, to wszak język i mowa.

I już na koniec rozważań o architekturze i o słowach. Piękna, dobra. Czas zmienia nasz język, nie używamy zawsze słów tych samych dla tych samych rzeczy, zjawisk. Słowo „piękno" straciło swe dawne znaczenie, używamy go ostrożnie, zbyt jest pomnikowe, zbyt wysokie koturny. Tak jest i z architekturą. Przeciętny jej odbiorca, użytkownik, flaner, przechodzień, któremu jakiś budynek czy fragment miasta się spodoba i nie zastanawia się on, czy jest to też i dobre, powie: ładne to. „Ładne" to określenie dla sztuki oficjalne, w liczących się publikacjach, nie do przyjęcia, niepoważne. Nie przejmujmy się jednak, czas i tak o tym zadecyduje. I chyba ładne to odpowiednie słowo. Myślę, że powiedzenie o ładnym nosie kobiety ładny nosek (choć zdrobnień nie lubię) jest lepsze od Kuncewiczowej pięknego nosa - Wunderschöne Nase[15]. Jest jeszcze inne określenie, może jeszcze lepsze: fajne. Ale tego z pewnością nie darowaliby nam poloniści, strażnicy wartości języka, choć to nie oni, z całym szacunkiem, tworzą literaturę. Dziewczyna piękna? Czasem lepiej: ładna, a jeszcze lepiej: fajna. Chyba ten termin najlepiej wyraża aplauz dla fenomenu architektury i nie tylko jej :-).

Z architekturą podobnie jest jak z ludźmi. Domy są dobre i złe, ładne i brzydkie, często takie sobie. Jak ludzie. Fajnie, gdy są fajni.

A zatem: fajna architektura. W dodatku – rodzaju żeńskiego, jak dziewczyna.

PS Przypisy pozycji 3,4,6,9,12,13 są konsekwencją wcześniejszego, w innych miejscach, szerszego omówienia przez autora poszczególnych wątków.

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A DAY IN A SHADOW OF HIGH-RISE – 3D PARAMETERIZATION AND USE OF PUBLIC SPACE AROUND PŻM / HOTEL RADISSON BUILDING COMPLEX IN CENTER OF SZCZECIN

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Abstract
The paper is related to issues of application of advanced computer techniques applied to analyses of public space use in urban areas. The particular interest is directed towards 3D city models and possibilities of urban analysis of street life using such environment. It is also focused on public spaces located nearby tall buildings in key areas of city centers. The article presents a daily analysis of street life beneath one of several tall buildings in city center of Szczecin, Poland. Further on, it presents possibilities and process of parameterization using computer techniques, both 2D and 3D. The sample results focus on patterns of use and their relation to urban environment of public space it occurs. The presented sample results are the opening of wider advanced research to be applied to more complex systems of public spaces.

Keywords: public space; tall buildings; 2TaLL; 3D city models; parameterization

INTRODUCTION

A common day. A life in urban space is awaking. A daily game of urban activities begins again – some places remain still in silence, some are becoming a real hot spots of the city. Three-dimensional spaces between buildings are being filled with more and more users, objects and movement – the life between buildings is just reviving.

Szczecin is a case of city, where the hierarchy and system of public spaces is not clear in sense of connections between different public areas, spatial continuity and accessibility for users. The public spaces are scattered in the city, only few are connected in some continuous spatial and functional system. The other remarkable feature of Szczecin is fact, that apart from historical towers of churches, castle[1] and some old public buildings[2], it is basically the city of two new high-rise buildings[3]. One of such hot spot spaces in the city appears directly at one of those buildings - PŻM / Hotel Radisson high-rise complex at Rodła Square in part of the city center (Fig. 1.). The presented Visibility range analysis (using 3D city model[4]) for the high-rise complex shows importance of the localization for the entire city center area (Fig 2.). The relation between localization of tall buildings in cities and system of public spaces is a part of scientific interest in the ongoing EU project at WPUT[5] in Szczecin. The 2TaLL

[1] Castle of Pomeranian Dukes in Szczecin
[2] Maritime Academy, National Museum, City Hall etc.
[3] One of them is the mentioned PŻM / Radisson Hotel Complex and the other is local TV building.
[4] 3D model and analysis developed by team: prof. Waldemar Marzęcki, PhD Klara Czyńska, PhD Paweł Rubinowicz at WPUT, Cyber Urban Center (CCU)
[5] West Pomeranian University of Technology Szczecin

Fig. 1. Rodła Square in Szczecin – view towards PŻM complex
Source: www.mmszczecin.pl / Google Street View

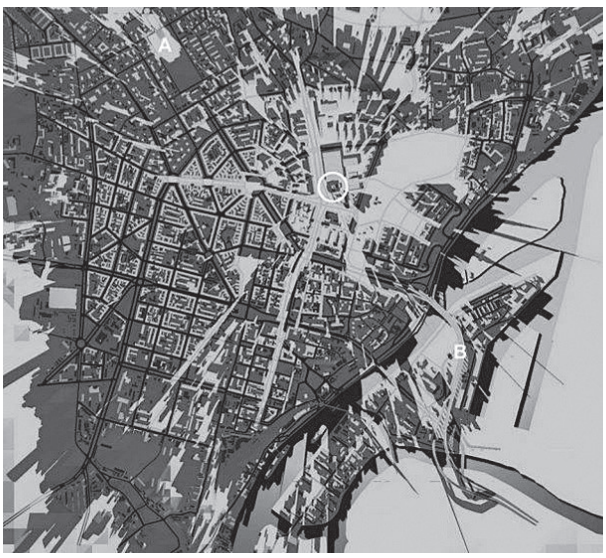

Fig.2 Visibility range analysis of PŻM complex
Figure by Klara Czyńska, WPUT, CCU

project[6] relates in priority to high-risers in cities – dominating, shaping cityscape, attracting public spaces – but also enabling views and visual observation of the urban space beneath.

1. RECOGNITION AND OBSERVATION

The essential for concept of this paper is understanding public space as three-dimensional void between built-up structure of the city, with implication of fourth dimension, which particularly is movement of users in certain time (Fig. 3). The other fundamental observation is the ongoing process of application of more and more computer techniques to urban analysis of cities. The especially interesting and promising seems to be application of 3D city models to advanced urban analyses of different cityscape issues. The application of such techniques is not novel itself, the pioneer and most advanced techniques have been developed and presented mainly by Space Syntax. "*Space Syntax is a set of theories and tools used for spatial morphological analysis with particular applications in urban science"*[7] – this principles have initiated a number of various advanced analyses introduced to urban space of cities, also using 3D environment in some extent. The spatial cognition and axial map issues have been raised for example by Alan Penn[8], the advanced ABM (Agent-Based Modelling) is being developed by Crooks and Batty[9], some advanced quantitative methods have been presented early in 2000 by Turner[10], also issues of social logic of space have been raised early in the 80's by mentor of Space Syntax – Bill Hillier[11]. There are much more issues developed in form of advanced urban analyses applied with computer techniques and it only enlightens a platform for integration of different analytic problems in 3D city models environment. The parameterization in understanding and exploring urban environment is a common and ongoing process in the face of new urban challenges and development.

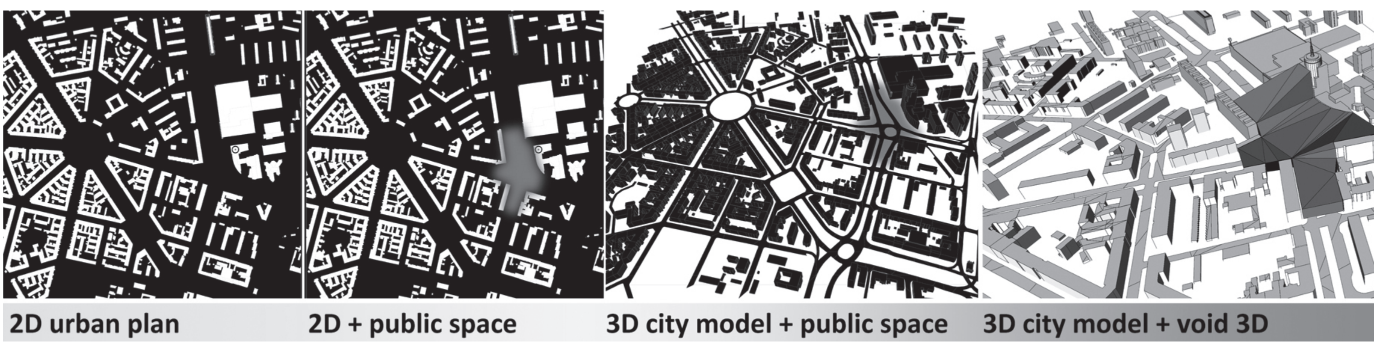

Fig. 3. Fundamentals of approach: a shift from urban plan to 3D city model and 3D void spaces. Selection, recognition and conversion into 3D solid geometry; source: by author based on 3D city model of Szczecin by CCU

The other crucial aspect of cityscape and urban life is observation of users. Simply saying, how all this shapes on plans, solids in three-dimensional urban space, are functioning? The most important approach to observation of users' nature in public spaces was initiated by Jan Gehl[12]. The common language of observation – using notes, drawing patterns of movement, counting people in public spaces and all elementary techniques have surprisingly indicated the most interesting conclusions on urban life and social behavior in urban space.

The area of Szczecin selected for the observation combines both of the mentioned aspects. The use of high-rise building complex has two reasons: firstly the PŻM / Radisson Hotel complex, together with adjacent commercial shopping centre Galaxy, is the strongest attractor for users in sense of functions offered (intensive office / administration area and shopping centre) – secondly, the high-rise building becomes a tool for observation and recording of urban life from above. The fundamental of basic observation of space use is inviolable itself, but introduction of computer techniques (such as automating the process of pedestrian count from sequence of static pictures or interactive system of spatial monitoring of urban space) could contribute to advanced computer database useful for observation and transformation of cityscape. In the following section, some ideas of analytic approach and directions for implementation of 3D city models for analysis of public spaces will be introduced.

2. FROM A MANUAL SCRATCH TO COMPUTER SYSTEM

Combination of two different techniques and approaches (manual recording of pedestrian movement supported by sequential photography and 3D interpretation of space between buildings as spatial solids) was used to prescribe some concept of using environment of 3D city models for creation of general 3D maps and systems of pedestrian flow (streams, hot spots) and urban attractors / barriers for larger areas of city (Fig 4a).

Analysis of sequential photos from a daily observation of urban life at the high-rise complex has just proved that, there is a clear and direct relation between functional attractors and patterns of movement. The presented patterns are just a sample of large data from observation. The observation has also delivered data on cyclic and repeatable pattern types strongly determined by public communication system in the area. The collected data also proves the observation about scattered and unlinked public spaces – the recording of pedestrian flow show that 'streams' to other public spaces are barely unused on foot. The public communication delivers systematically huge number of users moving just only towards the main urban 'attractors' of the area. The simplified example of presentation of system of streams and hotspots for pedestrian pattern of use shows possible process of converting data from manual techniques to 3D environment (Fig. 4a.). The 3D solid of space between buildings (Fig 4b.) has also potential of mapping functional attractors of public spaces (red – commercial / grey – residential functions).

The three sample patterns of pedestrians in the space show a kind of cycle of flow pattern and clearly indicates the difference between small and dispersed number of users while there is no incoming people by public transport (left side of Fig. 5), and intensive flow towards main attractor of PŻM complex and commercial centre while public communication comes to the area (right side of Fig. 5). Using such data on patterns of flow as combination with 3D model of public spaces and analysis of so called attractors could bring useful system of observation and recognition city areas predestined for different type of urban interventions to strengthen and improve system of public spaces.

3. CHALLENGES FOR 3D ENVIRONMENT

Adaptation of fundamental manual techniques of observation of urban life to more parameterized and computational environment of 3D city models seems to be possible and achievable challenge. Once, programming 3D model – it can recognize and define typology

[6] The 2TaLL Project is funded by Norway Grants scheme and presently is in the implementation stage at WPUT, Szczecin. The project subject is Application of 3D virtual city models in urban analyses of tall buildings. The author is in the project team together with PhD architect Klara Czyńska, WPUT, Szczecin and PhD architect Paweł Rubinowicz, WPUT, Szczecin – within the newborn Cyber Urban Center (CCU) at WPUT. The 2TaLL has been initiated in 2013.

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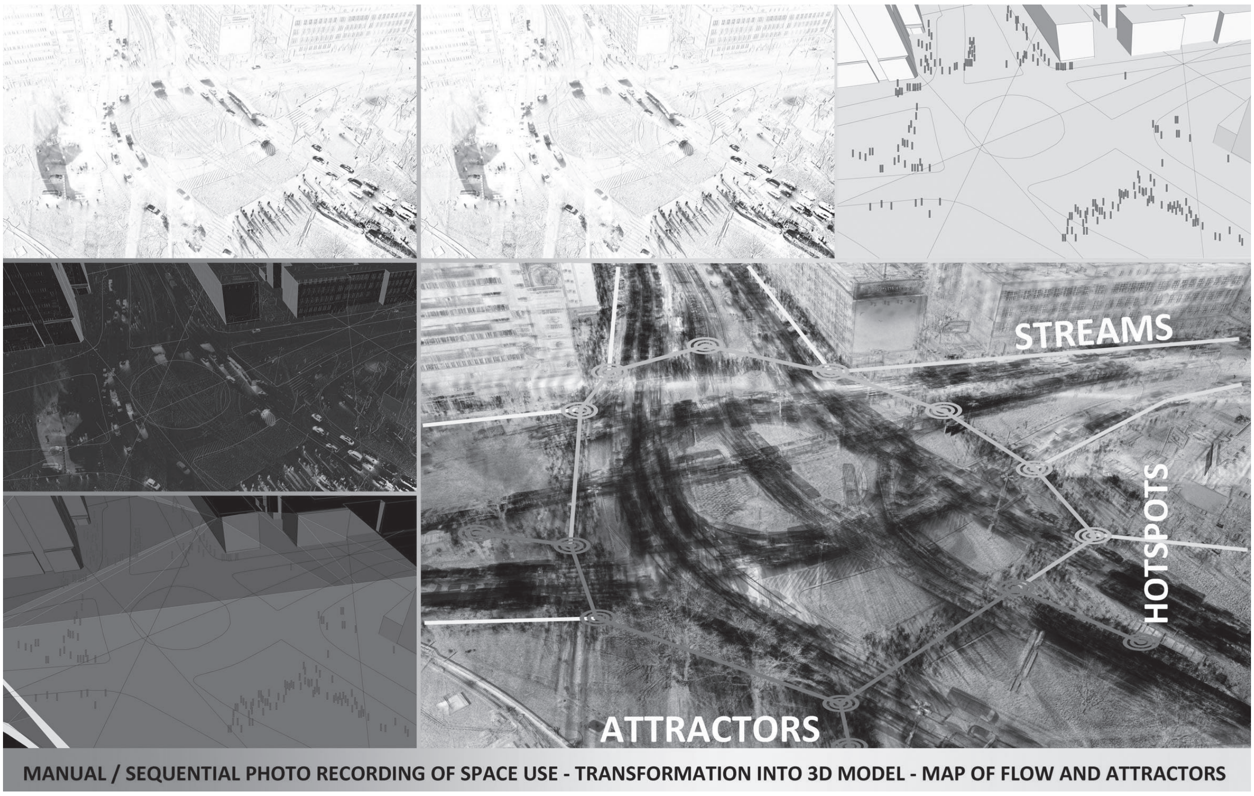

Fig. 4a. Shift from manual observation supported by sequential photography towards combination with 3D environment of city model – with possible introduction of animated schemes. Sample map of streams / hotspots / attractors in 3D model; source: by author

of spaces between buildings. Following, it is still a kind of difficulty, but definition of 3D map of public spaces is also achievable. Then, while adding system of attractors and hotspots, and using computer techniques to transfer manual photographs into real count of users – the 3D city model could become a spatial database of parameterized answers to the primary question of how the urban life goes on?, either in direct shadow of high-rise commercial and office complex, either in calm urban square linked by viable street or neighborhood. The main challenge is to build with support of computer programmer an algorithm for conversion of data and to create common platform of models to apply.

The day in a shadow of high-rise has brought answers on urban rules determining pedestrian patterns, has delivered extended data for processing, but has just only opened mind and prescribed challenges and opportunities of parameterization using 3D city models.

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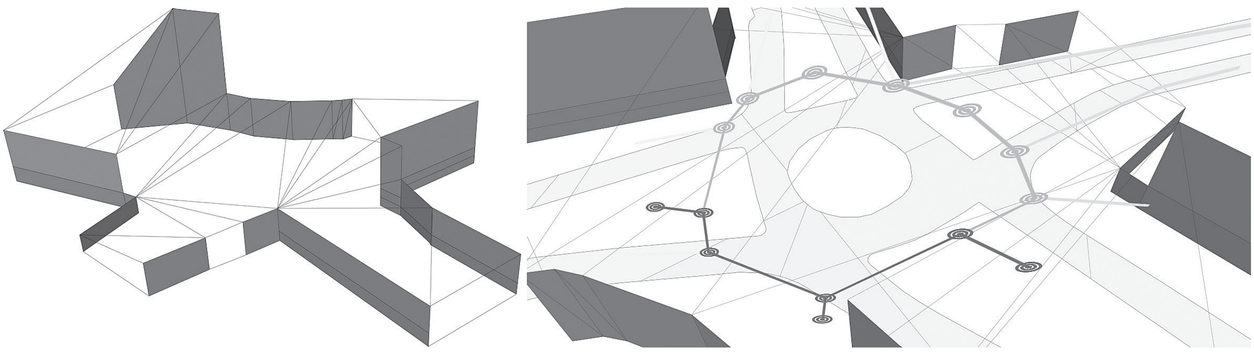

Fig 4b. Sample from 3D city model with example of 3D void between buildings presenting functional attractors on side surfaces /simplified scheme of streams / hotspots / attractors; source: by author

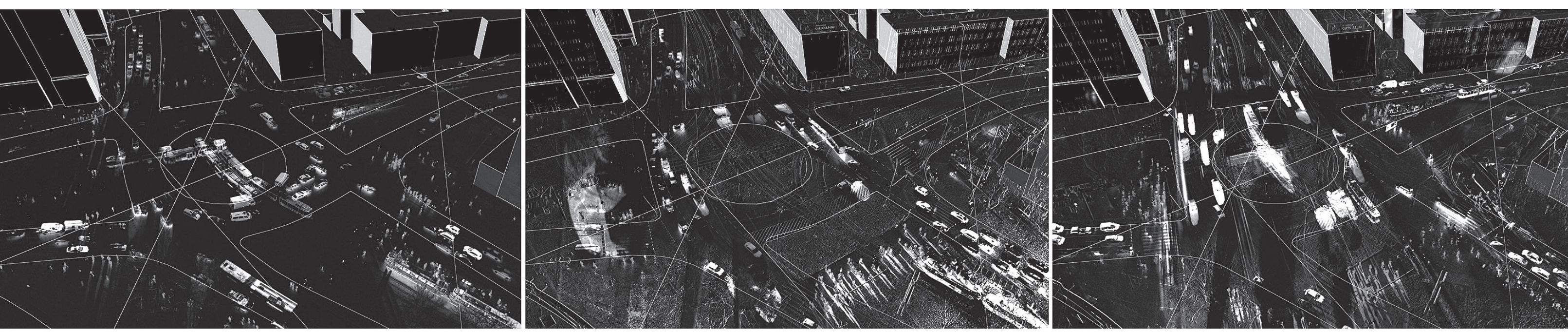

Fig. 5. Three sample types of pedestrian movement patterns due to incoming users by public transport. Visible intensive flow towards functional attractor – red color; source: author