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 5th and 7th 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

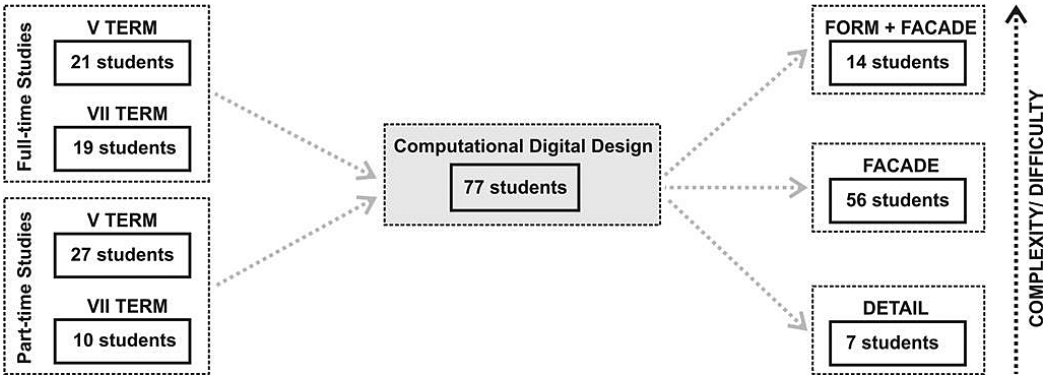

Fig. 2. Computational Design Techniques course structure; source: by authors

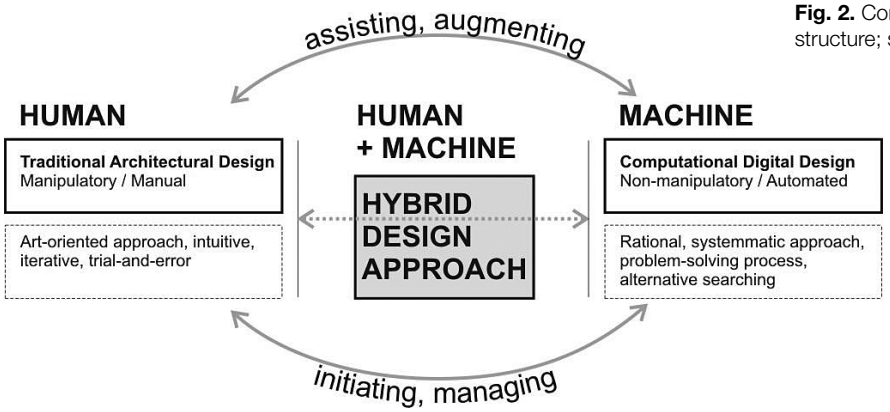

Fig. 3 Hybrid Design Approach in architectural design; source: by authors

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

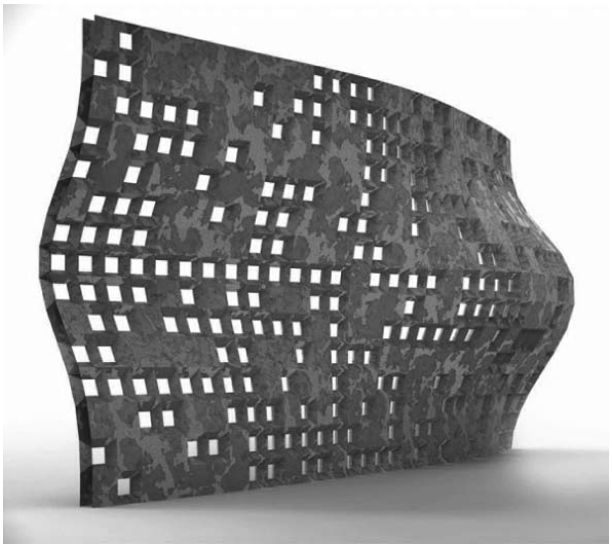

Fig. 5. Facade, Front curtain wall, Stępkowki Radosław, Sopot College

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

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