

EVOLVING THE EDUCATION PROCESS OF DESIGNING SUSTAINABLE BUILT ENVIRONMENT. A CASE STUDY.

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ABSTRACT

The aim of the research is to improve the quality of education in the field of sustainable design at the Faculty of Architecture of Wrocław University of Technology. The paper describes subjects and courses on sustainability and the effects of evolving the learning process on the example of the course “Designing Sustainable Living Environment” in the years 2011-2015. The study involved three groups of 30 students enrolled in classes taking place at the 2nd degree studies.

In subsequent years, output parameters (size of the project: area and population) and the method of drafting were changed. Studies have shown that over four years, the general knowledge about sustainability among students of architecture has improved, although it is generally still unsatisfactory.

Mastering the skills of design was more effective when developing a smaller area and a smaller number of inhabitants. Students performed better if, before the final draft, they developed only a single issue/problem like: passive energy gains, renewable energy sources, water management, public spaces and accessibility or urban natural systems to mention just a few. Designing sustainable housing units is a complex and novel issue in Poland, and so is teaching in this field. It is necessary to improve the level of students' knowledge at an earlier stage of education and generally raising awareness of sustainable issues. The results of research can serve as a know-how to other teachers and practitioners.

Keywords: sustainable development, didactics, integrated design process

INTRODUCTION

[...] Young people come to the university, they want to be architects, they want to know if they have a gumption. What do I tell them in the beginning? First you have to explain to them that it is not standing a teacher in front of them, who asks questions and downhill knows the answer. Creating architecture means asking yourself questions, means getting closer to your own answers, to hover around them and find them with the support of the teacher. Forever and ever. [...] [1]

After several years of design classes "green buildings - design problems" led for a small group of students and as non-obligatory course, the Faculty of Architecture on the Wrocław University of Technology finally stood before a chance of encompassing a larger group of future architects with education aimed at sustainable design. This was possible because after the introduction of a two-stage model of study, and due to establishing a new specialty: Urbanism; and simultaneous efforts to launch an experimental educational path - Sustainable Architecture.

Both actions were to draw from past experiences in leading classes, which aim was to implement ecology in architectural design.

Looking for opportunities to improve learning outcomes it was decided to change the method of transferring theoretical and practical knowledge.

FIRST STEPS

In the case of educational path Sustainable Architecture a set of courses was developed, which as a whole offer insight into the sustainability and environmental issues in the built environment, moving from the general (urban strategies) through neighborhoods (designing structural units) up to individual buildings and their functioning (ecological architecture and environmental performance of buildings). The novelty was creating opportunities to work on only one design theme for two semesters, in a workshop mode, with a small group of students for seven hours per week. As a result, students had a chance to thoroughly acquaint the problems of urban development, the design of compact settlements and specific green building solutions while preparing to work in an integrated design process and the with rating systems such as LEED or BREAM [2], [3].

The two completed years of work allow us to conclude that such a design mode brings a significant improvement in the amount of knowledge they have acquired, proven with the quality and detail of completed projects, as well as the results achieved by students at the master's diplomas. Visible is also generally higher level of interest in sustainability issues, which we hope will translate into the use of eco-friendly solutions in their future practice.

CAUSE AND AIM

And up to now it was not the best with that knowledge and practice. Students ended the first stage of studies showing rather poor knowledge of sustainable design problems, as evidenced by the results of tests carried out during the first class, as surveys of competence.

Questions were asked about the foundations of knowledge about sustainable development, green building components and assemblies i.e.:

- What is environmental impact assessment?
- What is an ecological corridor?
- What is the life cycle of a building?
- What is a passive house?
- What is sprawling?
- What is the Declaration on Environment and Development?
- What is primary energy?
- What is water retention? What is the purpose of it?

In subsequent years, fewer and fewer students entering the second stage of studies knew how to answer correctly to the questions, and the percent of positive responses from the beginning it was not satisfactory. Competence test results in particular years are presented in Table 1.

Table 1. Competence survey results of students entering the second stage studies.

year	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
percent of correct answers	20%	31%	33,5%	15,81%	11,71%

Reprogramming classes was therefore attempted, to fill these gaps in knowledge as soon as possible. It should be noted that due to the transition from single-stage course of study to a two-stage system, the Faculty of Architecture is entered by students from many very different educational institutions, and thus - also with very diverse knowledge and skills. This hinders the further implementation of the new teaching methods.

EDUCATION GOALS AND TEACHING STRATEGIES

Following establishing a new specialty: Urbanism, a new course was created titled "Designing Sustainable Housing Environment". The lessons are obligatory for first year master degree students of the new specialty.

The course in question is primarily to acquaint students with problems of environmental resources management within urban and suburban areas. It thoroughly discusses the factors affecting the consumption of natural resources in urban areas: energy, water, raw materials, land, and those affecting the quality of living and nature. The students completing the course should be able to collect, process and analyze data as a basis for calculating the environmental parameters, sustainable development indicators and standards of investments in urban scale. They should also have the ability to determine the relationship between the value of these indicators and the quality of human life in the urban environment. Urban projects prepared by students should be in line with the conclusions of the analysis of predesign stage and with the assumptions and objectives which take into account sustainable development.

The content of the project has evolved over four years since it was established. The first two editions were based on a project of a residential complex for 3500 - 4000

inhabitants with services in selected locations in Wrocław and area of about 25 hectares. The first lesson, also as a kind of test, consisted of the choice of this location from about 10 proposed. In addition to preparation for the next lesson, the aim of the first one was to identify, which factors students consider relevant to a construction of a sustainable, compact, multi-functional neighborhood of predominantly residential function. Further steps in the course consisted in carrying out studies of the selected location. The whole group (30 students) shared tasks - analyzes: functional and spatial, natural and cultural environment and landscape composition. The information collected and compiled at this stage were developed in a manner allowing mutual transfer, so that before the stage of project proposals, project groups (3-4 students) have complete documentation.

The main part of the course was to develop a compact neighborhood unit that meets the design principles of sustainability. Initiated with the preparation of functional and spatial program, students then proceed to making the concept plan in the scale of 1: 2000. This is to provide a basis for further work involving the implementation of selected sustainable solutions: low footprint landscaping, energy and water; developing a green system, waste management and solutions aimed at avoiding social exclusion (whether disabled, or with lower incomes). An important part of the project was the final evaluation of the environmental performance, on the basis of proprietary set of sustainability indicators.

The final grade was dependent on the merit of the project: finding the optimum variant, innovative and rational solutions as well as interesting spatial arrangement and functionality. Not without significance was the activity in the class, as a large part of them was devoted to presentations of projects and discussions on them.

One of the final drafts is presented in Figure 1.

After two years of operation of the classes discussed, it was decided to change their formula. This was in large part due to worse outcome in the group of 2012-2013, but also comments of students themselves (each course ends with a voluntary survey evaluating the activities). They pointed out the very time-consuming adjustment of such a large design owing to new variables emerging from week to week (preserving the earth's surface, maximizing passive heat gains, the introduction of renewable energy sources, protection of existing and creating new ecological corridors or solutions for people with disabilities), at continuous attention on compliance with the existing law. On the one hand, you could not skip these topics, as important in the education process towards sustainability. On the other hand - because of previous arrears - one could not require that all relevant issues have been implemented at once. They need prior, at least a cursory, discussion, and that takes time. This resulted in considerable shortcomings in projects and delays in the implementation of the program.

It was therefore decided to make changes.

They consisted of a significant reduction in the area of studies (with more than 20 hectares to about 5 ha) and reducing its functional program (for about 1000 inhabitants). From now on, each design group (the group was still 3-4 students) worked on a project in another designated location.

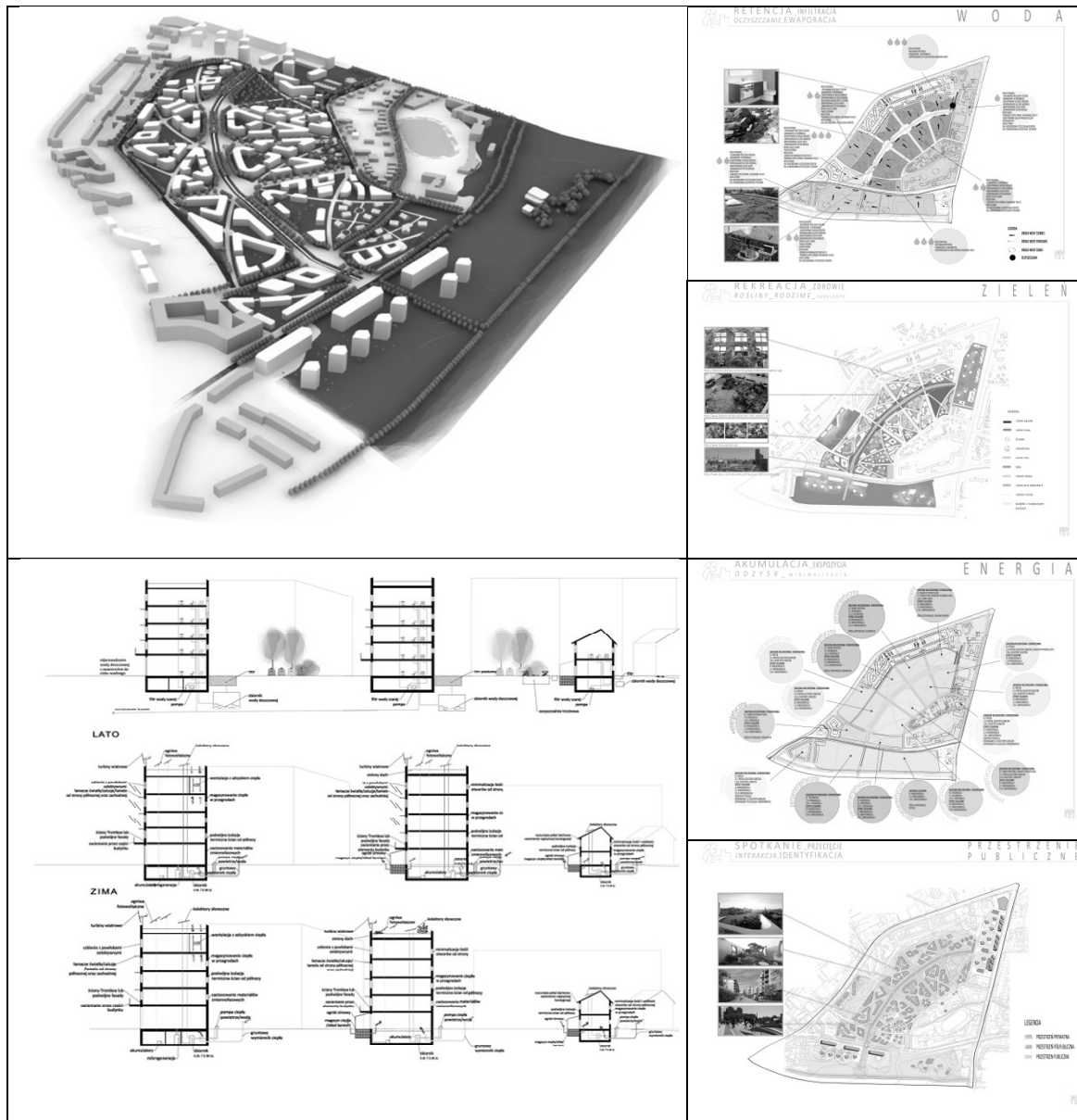


Figure 1.

Example of a design from the first year of class "designing sustainable housing environment": top-down, left-right: aerial view, water management, green system, sections, energy standards, accessibility.

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Above all, however, the design mode has changed. So far one project has been developed by introducing the amendments to gradually take into account the additional requirements of the principles of sustainability.

Now the proposed mode relies on sequential design of 6, various, small neighborhoods, optimized only for one variable. Fixed was only the design area.

Successively projects were units in which students:

1. minimized interference with the terrain and natural features of the area: "minimum footprint"
2. maximized passive energy gains: "passive max"
3. maximized energy production from renewable sources: "eneractive"
4. maximized retention of rainwater and potable water savings: "water balance".
5. completely subordinated to the urban layout to protecting and/or restore the natural ecosystem, "green system" and
6. adapted the whole unit and its individual parts for the needs of people with disabilities: "one for all".

Even further simplification was made, allowing to come up with projects that did not comply with applicable law. The only criterion for assessing projects (called partial) was to achieve an optimal solution for a given - one for a design - problem.

However, in order to drive the students back to reality, the last five weeks was devoted to the development of a "summarizing" design, in which students, on the basis of the experience gained in the performance of sub-projects, implemented selected, well-reasoned solutions, this time in accordance with applicable regulations. So we can say that with a solid foundation, given by discussion over design issues extracted from the other, at the end students made a multi-criteria optimization - the daily bread of designers.

Other elements of the course program remained unchanged. Projects are preceded by an in-depth analysis of location and complete the assessment of the environmental performance of proposed solutions.

An effect of such organized course is shown on Figure 2.

The first edition of the course after the changes did not end with a spectacular success when it comes to the level of student works. But even then (a year ago) course participants pointed out, that despite (seemingly) more work, performing several smaller, thematic projects, gives them more than making one large project. This is perhaps related to the way of teaching across the Faculty of Architecture: virtually all design courses are based on the performance of one large project over all 15 weeks of the semester.

When there are several similar courses, the students must divide the work week and their attention to small parts anyway. It's then better to perform multiple short tasks, instead of one large.

CONCLUSIONS

Last semester (2014-2015) in terms of the level of projects and the results of the examinations was much better. Both the system of classes, and the scope of the problems was, according to those surveyed, appropriate:

[...] The classes were conducted in an accessible manner. We had to put in very much work that is both an advantage and a disadvantage, because it was the hardest class in this semester. Very well that every problem was perpetuated by a partial design, which is an interesting approach, I never met earlier in college. [...]

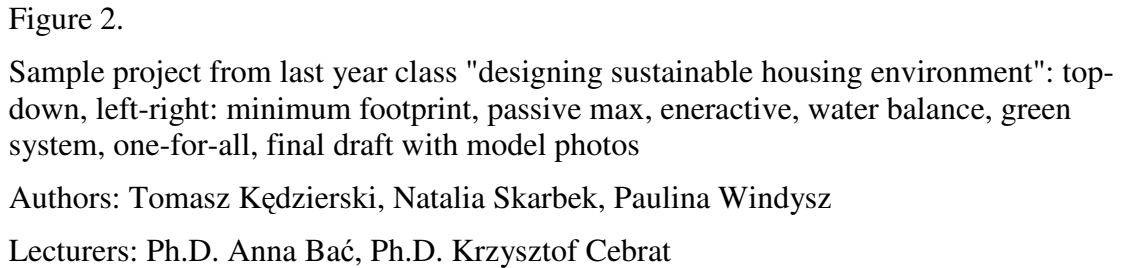


Figure 2.

Sample project from last year class "designing sustainable housing environment": top-down, left-right: minimum footprint, passive max, enenerative, water balance, green system, one-for-all, final draft with model photos

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Although it must be recognized that there was visible "fatigue" in developing the 6-th concept... .

Generally, it should be noted that mastering the issues of designing sustainable neighborhoods is more effective when it relates to smaller facilities, designed for a smaller number of inhabitants and when particular issues are considered separately. This is undoubtedly related to the extent of knowledge that should be mastered. Buildings design, which takes into account issues of sustainable development is still a sort of novelty in Poland. More than other problems, designers attention is attracted to narrowly conceived energy efficiency - also due to the tightening up law. Meanwhile, true sustainability is a task far more complex.

The education path "Sustainable Architecture", and the discussed course "Designing Sustainable Housing Environment" are so far the only courses so widely dealing with issues of sustainability in architectural design and urban planning. For the sake of the environment that architects and planners create, there should be more similar actions, at an earlier stage of education.

ACKNOWLEDGEMENTS

The described methodology and design classes form are the authors own experience of many years of work with students of the master's degree at the Faculty of Architecture of the Wrocław University of Technology. Many of the changes made over the years in the mode and manner of teaching architectural design stems from own and colleague's observations of the best effects (judging by the level of drafts and the results of the exams), but also a lot in the experience of others. Especially valuable are the insights regarding the recent problems in separation of technology from architectural design [4], the description of the different ways of learning architecture over the years [5], and finally hints of problem approach to design [6].

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