

Building engineering issues in Architectural education in Poland, in context of actual Ministry of Science and Higher Education Regulations

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Abstract: The article presents the curriculum for architectural studies in the context of technical courses, such as building engineering, structures, materials science and building physics. The authors of the publication compare the method of conducting these courses and their participation in the entire study program on the example of selected Polish universities (Faculty of Architecture of the Wrocław University of Science and Technology, Faculty of Architecture and Building Engineering of the Lublin University of Technology and the Faculty of Technical Sciences, University of Applied Sciences in Nysa). Authors of the article present changes that have occurred in the curriculum of these courses before and after the reform of higher education from 2019, what impact it has on the education of future architects, and what new opportunities these changes offer will be analyzed.

Keywords: engineer education, architectural education, engineering courses, general construction, education reform

Introduction

Architectural education is a subject of discussion in both professional and scientific circles. Its criticism mainly concerns putting too much emphasis on the formal, spatial, visual and theoretical aspects of architectural design and separating them from technical subjects, which are often taught in an unattractive, simplified and non-visual way [14], [13], [3]. Currently, the changing realities of the architect profession in accordance with economic and climatic conditions, the increasing share of the importance of social competences and “business” skills, and most of all the introduction of BIM tools, mean that educating architects today should differ significantly from that of several years ago [6], [11]. So far, teaching construction and engineering at Polish universities could be conducted autonomously, without relation to design subjects, but due to the new teaching standards the situation has changed. The current Ministry Regulations [12] and trends modelled on Western European and global solutions are aimed at raising architectural education to a higher level, adjusting education from the first years of studies to the realities of the profession where multi-industry is a key issue. For this purpose, the problems discussed in design subjects overlap and complement construction and engineering subjects. Students learn about general construction issues not only in theory but also in relation to their own projects, which shows the inextricable relationship between engineering and architecture.

Current reform of higher education in the country [12] has brought significant changes of the program for architectural studies:

- an increase (to nearly 50%) in the share of design classes in the total number of hours;
- a compulsory one-semester design work placement carried out during the course of study;
- the curriculum standard for the Long-cycle Master’s degree program;
- detailed definition of learning outcomes by groups of activities;
- increasing the number of semesters (in first cycle studies from 7 to 8) and the minimum number of hours in the program (in first cycle studies from 2500 to 2800, in second cycle studies from 900 to 1000) [7] [8].

Polish Chamber of Architects draws attention to the need for each autonomous university to adapt the new standards individually, according to its needs, position, location in the region and the mission it fulfils in the system of scientific, professional and social education [9].

Research Method

The article uses a comparative research method. The engineering group of course curriculums in architectural education, for first cycle studies, on the example of three universities in Poland, has been analyzed and compared before and after the reform [12]. A particular emphasis has been put on the syllabus changes of General Construction course (or Building Engineering course – the name of the course is used interchangeably at universities), as the basic and leading subject of the engineering group of courses. The curricular changes will be presented in tabular form, for each of the presented university. It aims to demonstrate the autonomous approach of universities to implementing curricular changes and to seek the best standards for implementing these changes.

Three public universities were selected for research, differing in the age of their foundation, size, as well as traditions and teaching methods. At the same time, each of them is representative for its group: Wrocław University of Science and Technology belongs to the group of large universities with many years of teaching tradition in the field of architecture, Lublin University of Technology is an example of a public university where teaching architecture coincided with the introduction of the Bologna system, and the University of Applied Sciences in Nysa belongs to the group of higher vocational schools, created to meet educational needs in smaller centers.

Faculty of Architecture at the Wrocław University of Science and Technology

Wrocław University of Science and Technology is one of the largest technical universities in the country, with thirteen Faculties and around 4000 graduates each year. Since 1945, the Faculty of Architecture has functioned within the structure of the Wrocław University of Technology, initially as a division of the Faculty of Construction, and since 1949 as an independent Faculty. Since 1950, the Faculty of Architecture has received full academic rights to confer the degree of Doctor in technical sciences, and since 1960, continuously, the right to confer the degree of Doctor with Habilitation Degree.

Share of engineering courses (hour schedule) in the curriculum at the Faculty of Architecture of the Wrocław University of Science and Technology [Table 1].

Table 1. Hours schedule of technical courses at first cycle studies (engineering), before and after the education reform according to the Regulation of the Ministry of Science and Higher Education of 18.07.2019 [16][17] at Faculty of Architecture of the Wrocław University of Science and Technology. Forms of courses: L – lecture, E – exercise, D – design, S – seminar.

Course / group of courses Form of course →	Standard of education PRE – REFORM (hours)				Standard of education POST-REFORM (hours)				General remarks
	L	E	D	S	L	E	D	S	
Building Materials Science	15	15			15	15			Number of hours and syllabus content unchanged.
Mechanics of Structure	45	45			30 (–15)	30 (–15)			Reduction in the number of lecture and tutorial hours.
General Construction	45	60	75		15 (–30)	75 (+15)	0 (–105)		Significant reduction in hours, lack of individual construction designs (changes will be detailed in the next chapter).
Civil Structures	30	120			0 (–30)	60 (–60)			Significant reduction in tutorial hours. No lectures.
Building Physics	15	15			15	15			Number of hours and syllabus content unchanged.
Building installations and urban technical infrastructure	30			15	30			0 (–15)	Lack of seminar classes, allowing to learn in detail the problems of designing building installations.
Total hours:	180	255	75	15	105 (–75)	195 (–50)	0 (–75)	0 (–15)	

The number of hours from the technical course group has been reduced, but some subjects e.g. General Construction will be introduced into the Architectural Design courses. However, it is currently difficult to predict what their share will be in real terms, on an hourly basis. In addition, in the second cycle, the number of hours of the Structural Engineering course is supplemented by the *Structures in Modern Architecture* course (lecture 30 h, tutorials 60 h, total for 1 and 2 semesters of the second cycle program).

General Construction course reform changes for Faculty of Architecture of the Wrocław University of Science and Technology

A post-reform fundamental change in the general construction course is its reduction from a four-semester cycle to a three-semester cycle. In the first semester, the program is implemented without any changes, the aim of which is acquisition of elementary knowledge of technical drawing, basic elements and structures of buildings, acquisition of skills in recognizing and interpreting basic elements and structures of buildings, learning and acquisition of the skills to apply the basic regulations in force in the construction industry. The course

is conducted in the form of drawing tutorials. The second semester of general construction before the reform took the form of a design task on which the students had designed a staircase in a detached house on a scale of 1:50, including detail drawings. Students applied the knowledge acquired in the previous semester in practice. A post-reform course develops and supplement the knowledge of technical drawing, basic elements and systems of buildings, skills in recognizing and interpreting basic elements and systems of buildings, – learning and acquisition of the skills to apply the basic regulations in force in the construction industry. The course is conducted in the form of drawing tutorials. The third semester before the reform was carried out in the form of exercises aimed at broadening the acquired skills. Students were able to search for, analyze and select information from a variety of sources on the use of appropriate materials, structures and building technologies in the design of a selected building system, use their skills in technical and construction drawings in practice. Students in the tutorials had developed a detailed design of a complex building form – a roof truss over a single-family house. After the reform, there will be no continuation of the General Construction course in its original form in the third semester. In the fourth semester, this course, before the reform, was the culmination of basic knowledge in the field of building construction and assumed the implementation of a technical project of a single-family house. It was conducted as design course. After the reform this course is conducted under the name Modern Building Solutions and it aim is to acquaintance with modern construction solutions, modern materials used in construction, development of skills of designing architectural and construction details. Classes are conducted in the form of multimedia presentations developed by students, with discussion moderated by the lecturer.

Within the post – reform General Construction course block a reduction in class hours is significant. Classes will not have individual design development as part of their syllabus content (in the previous teaching standard, the courses included two technical and construction designs). Due to increase of numbers of hours in design studio block, some engineering and technical issues will be developed in paralel to general design course, in so called Integrated Design Studio, which is to offset the reductions in hours in the engineering course block.

Architecture at the Faculty of Construction and Architecture of the Lublin University of Technology (FCA, LUT)

The Lublin University of Technology was founded on the initiative of the local community of technicians and engineers in May 1953 as the Evening School of Engineering. The Faculty of Civil Engineering was established in 1965, in the same year the university was transformed into the Higher School of Engineering, and in 1977 into the Lublin University of Technology. In 1986, the name of the Faculty of Civil Engineering was changed to the Faculty of Civil and Sanitary Engineering, and within this faculty, architectural studies were launched in 2004.

Share of engineering courses (hour schedule) in the curriculum at the Faculty of Construction and Architecture of the Lublin University of Technology [Table 2].

Table 2. Hours schedule of technical courses at first cycle studies (engineering), before and after the education reform according to the Regulation of the Ministry of Science and Higher Education of 18.07.2019, [2], [4], at Faculty of Construction and Architecture of the Lublin University of Technology. Forms of courses: L – lecture, E – exercise, D – design, S – seminar.

Course / group of courses	Standard of education PRE-REFORM (hours)				Standard of education POST-REFORM (hours)				General remarks
	L	E	D	S	L	E	D	S	
General Construction	60		30		60		45 (+15)		Increase in the number of hours (changes will be detailed in the next chapter)
Mechanics of Structure	30	30	30		30	30	30		Transfer of the subject from semester 1 to semester 4 in order to coordinate the content with issues of building structures.

Materials Science	30			15	30			15	The scope of materials testing in the laboratory has been expanded.
Structural Engineering	90	30	30		30 (-60)	0 (-30)	30		Reduction in hours. Significant reduction in scope.
Building Physics	30	15		15	15 (-15)	0 (-15)	15 (+15)	15	Introduction of design classes, extension of the syllabus contents with acoustic issues.
LIS and ordinance survey maps	15			30	15		15		Changes in the name of the course, before the reform: Land surveying (5 th sem.). Change of the form and scope of classes after the reform (3 rd sem.)
Roads and Streets	30				15		15		Change in the form of classes (design added)
Construction Technology and Organisation	30		15	15	15		15		Before 2 nd sem. (5, 6) subject: Technology and Organisation of Investment Process In sem. 6 Economics of Investment Process: 15 L, 15 D – subject eliminated
Building Installations and Urban Municipal Infrastructure	30		30		15 (-15)		30		Reduction in lecture hours – 15, ECTS credits by 1 and moving the course from sem. 4 to sem. 5
Total hours:	345	75	135	75	225 (-20)	30 (-45)	45 (-90)	180 (+105)	A total reduction of 150 hours in this subject group.

As a result of the reform, the number of hours from the engineering course group has been reduced by 150. There have been changes in the content of the syllabuses dictated by the need to adapt to the new standards and the shifting of subjects in the course of study. Major changes in syllabus content and hours allocated to the subject have affected Structural Engineering. Before the reform, the subject was implemented in 4 semesters, after the reform, structural engineering, in its basic scope, is implemented in sem. 5 and 6. Thus, the program content of the first cycle has been limited, in accordance with the scope required for the scope of architectural designs undertaken as part of the engineering studies, while at the second cycle the structural issues have been broadened to correlate with the difficulty of the subject matter undertaken during the master's studies.

General Construction course reform changes for Faculty of Construction and Architecture of the Lublin University of Technology (LUT)

At Lublin University of Technology, the main aim of General Construction course concerns learning about the classification and design principles of buildings, building systems and components as well as the basic regulations applicable to the construction industry [8, 9, 16], is continued, but the course shows changes, resulting from discussion between the teachers of engineering subjects and architectural design. It was agreed that a better understanding of construction issues would be achieved with freehand drawing as a tool in the initial stage of learning. The syllabus for design form of classes in the first semester, contents making drawings as well as architectural and construction details in traditional technology, in permanent technique. So far, students have the freedom to use the tools, which often resulted in a lack of understanding drawn structure.

In the second semester of study, the aim of the „General Construction“ is to develop architectural and structural assumptions for the design of a residential and multi-family building in traditional improved technology. Students are being taught how to draw plans of: foundations, ground floor, typical storey, roof trusses, roof and vertical sections, as well as how to prepare calculations of heat transfer coefficient of walls. Development of a technical description of the building is studied on individual examples of projects developed in design studio. It should be noted that the General Construction course is the only one in the group of engineering subjects taught in Architecture at the LUT to show a slight increase in hours after the reform.

As a result of the introduced reform, summer practices on the construction site (so far after the second year of first cycle studies) have been shifted to the second-cycle studies – master’s, so graduates of engineering studies do not get to know the construction site. In order to compensate for this shift in the curriculum resulting from the new teaching standards, didactic tours covering construction sites have been introduced as a form of teaching in many classes, so that the link between design and implementation is also visible in the first cycle studies. With an overall reduction in the total number of teaching hours in engineering subjects, the introduction of on-site practice as part of the course of study is an indispensable element of education.

Architecture at the Faculty of Technical Sciences of the University of Applied Sciences in Nysa (UAS)

The University of Applied Sciences in Nysa is a state vocational school founded in 2001 and in accordance with its Mission Statement it is part of the academic tradition of Nysa, oriented towards cooperation with the region and stimulates its development. The university plays an important role in the local environment and also fulfills an important cultural role, both in terms of popularizing science and the arts. The major of *Architecture* has been taught at the University since its establishment; currently, students have the opportunity to study at the first cycle level and also choose from 2 specialization: *Light Architecture* (LA) and *Conservation and Protection of Monuments* (CPM). The technical and construction subjects have been the basis of teaching since the beginning of the architecture major, irrespective of the specialization chosen.

Share of technical courses in the curriculum at the Architecture of the Faculty of Technical Sciences of the UAS in Nysa [Table 3].

Table 3. Hours schedule of technical courses in first cycle studies (engineering), before and after the education reform according to the Regulation of the Ministry of Science and Higher Education of 18.07.2019 [5], [1] at the Architecture of the Faculty of Technical Sciences of the UAS in Nysa. Forms of courses: L – lecture, E – exercise, D – design, La – lab.

Course / group of courses	Standard of education PRE-REORM (hours)				Standard of education POST-REFORM (hours)				Remarks	
	L	E	D	La	L	E	D	La		
Building Materials Science	45			15	30 (–15)				15	Slight reduction in the number of lecture hours. No changes in the scope of core syllabus content, discussed at a higher level of generalisation.
Mechanics of Structure	30	30			30	30				Number of hours and syllabus content unchanged.
Construction general education	60		60		45 (–15)		30 (–30)			Significant reduction of hours, especially limiting the scope of semester design development, which includes construction and execution documentation of a single-family residential building (changes will be detailed in the next chapter).

Structural Engineering	90	75	45 (-45)	45 (-30)	Significant reduction in hours. No changes in the scope of core syllabus content of lectures, discussed at a higher level of generalisation. Inability to relate the presented content to engineering practice in detail. Significant reduction in the scope of semester design development.			
Building Physics	15	15	15	15	Number of hours and syllabus content unchanged.			
Building Installations	30	15	15 (-15)	0 (-15)	Significant reduction in the number of lecture hours. Limited scope of core syllabus content, discussed at a higher level of generalisation. No design classes.			
Urban Technical Infrastructure	30		15 (-15)		Significant reduction in the number of lecture hours. Limited scope of core syllabus content, discussed at a higher level of generalisation.			
Total hours:	300	30	165	15	195 (-105)	30	90 (-75)	15

Curricular changes, resulting from the limits set by the educational standard, introduced in the group of subjects B.2: *Design Context: Engineering, Technique and Technology*, a significant reduction in contact hours in lectures (-105 hours) and design classes (-75 hours). The changes in the curriculum introduced at the University of Applied Sciences in Nysa were aimed at meeting the current formal requirements, while preserving the developed didactic methods, based on the presentation of theoretical content, supplemented with examples referring to everyday engineering practice. Some of the syllabus content implemented as part of the semester designs in the General Construction courses, was planned to be completed as part of the so-called Integrated Design. These classes, referred to as "design B" in the syllabuses, are implemented as general construction consultations for architectural and urban design (e.g. in the courses Single-Family Housing and Multi-Family Housing).

General Construction course reform changes for Faculty of Technical Sciences of the UAS in Nysa

The General Construction course will continue to be delivered in the form of a two-semester, but in a reduced number of hours. The first part of the course, implemented in the second semester of the engineering studies cycle, will slightly change after the reform. The aim of the course, without changes, is acquiring elementary knowledge related to technical requirements, technology selection, design and construction of simple residential buildings with traditional technology as regards foundations, walls, intermediate floors and chimneys. The number of hours for the design part is reduced from 30 h to 15 h after the reform. Course still take the form of a lecture and design classes. The second part of the course has been significantly reduced compared to the situation before the reform. Lectures and design classes were cut by half (from 60 hours before the reform to 30 hours after the reform). The program is implemented in a similar way. Aim of the course is acquiring elementary knowledge related to technical requirements, technology selection, design and execution of balconies and terraces, stairs, roofs and roof slabs and finishing works. Design classes aim to preparation of building cross-sections, roof plane plan, roof truss plan and cross-sections, and staircase drawings. However, after the

reform, due to time constraints part of the syllabus content related to the development of building sections, roof plane plan and construction-architectural details is implemented as part of the multi-industry consultation for the course “Single-Family Housing” from the Architectural Design subject group.

Conclusions

The introduction of the new educational reform enables a transparent comparison of the methods of its implementation at different universities. The university’s autonomy makes it possible to implement these changes in a way that best suits its needs and standards. At the Lublin University of Technology it has been decided not to combine the syllabus content of the engineering subjects with architectural design in a direct way, in favor of independent implementation of design tutorials, laboratories or tutorials. At the same time, the instructors of architectural and engineering subjects, during a series of meetings that accompanied the creation of new curricula, directly submitted their comments and expectations, which was a very important element in the development of syllabuses. At the Wrocław University of Science and Technology and the State Vocational School in Nysa, it was decided to integrate design classes and general construction courses. Such classes are to be implemented along the lines of Western European standards in architecture schools, where the so-called Integrated Design Studio includes multi-discipline architectural designs. However, not all universities have clarified, at the stage of preparing the new teaching standards, the hourly share in this form of classes to be allocated to general construction. This form of leading design courses is new for presented universities, and provides a comprehensive and multi-dimensional approach to an architectural design.

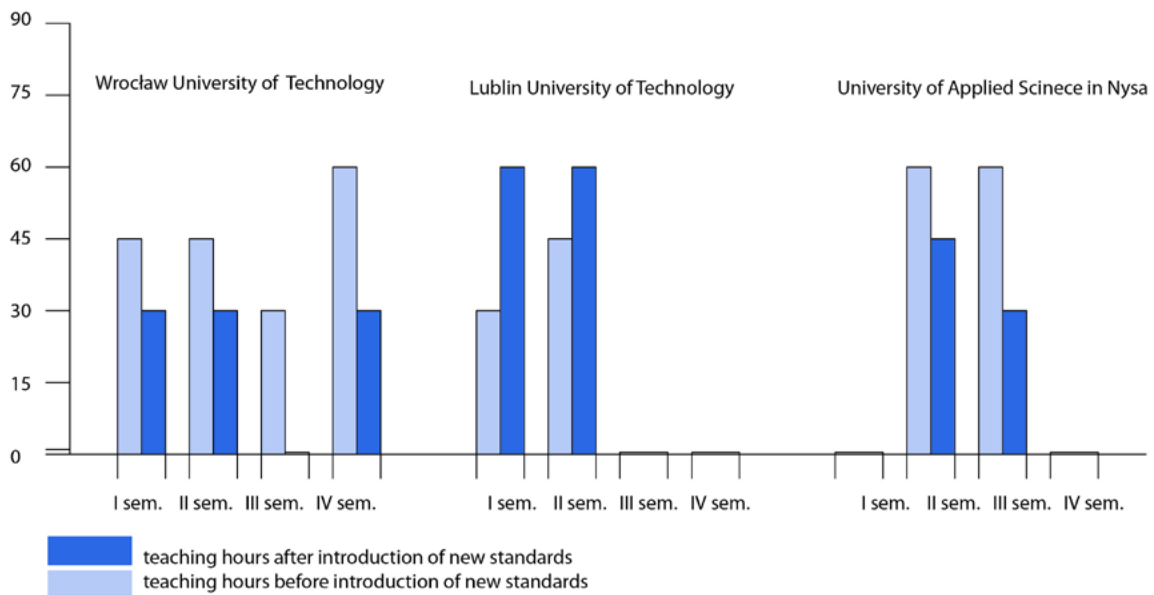


Fig. 14. General Construction course – comparison of the number of hours in a semester for the analyzed universities

We observe a significant reduction in the number of hours of engineering courses in all analyzed course curriculums, without major changing the syllabus content for the subject. Consequently it affects the impossibility of implementing the program without harming the overall training of engineering competences. The implementation of all topics in a limited time, requires the use of limited forms of presentation of the basic content, without the possibility of in-depth analysis and full reference to examples from everyday design and executive activities. The complexity of the process of education of technical courses, requiring a multidimensional approach – combining practical classes in the form of laboratory tasks or visits to the construction site, and theory, presented in the form of lectures and exercises, is shown by research on the education process of technical courses at the Faculty of Architecture by Bogdan Siedlecki [15]. Also experimental methods of teaching

a material science course based on practical and design classes developed and described by Paweł Mika [10] shows the important relation between the amount of time and commitment devoted to a given activity and the subsequent learning outcomes. Another conclusion is the need to transfer a certain range of tasks, so far carried out within the framework of classes, to the individual work of students in order to complete the full curriculum. Consequently, students will follow the program unequally, and knowledge enforcement may be problematic.

General Construction course reform changes (hours reduction) for analyzed universities are presented in Fig. 14, presenting the hourly schedule of classes in the following semesters before and after introducing the new standards due to Ministry Regulations.

References

- [1] Architecture first cycle studies curriculum, practical profile, University of Applied Sciences in Nysa, academic year 2020/2021, source online: https://www.pwsz.nysa.pl/bip/pliki/2/files/Architektura_2020.pdf (Access: 26 April 2021).
- [2] Archival study program (syllabuses) of subjects conducted at the Faculty of Civil Engineering and Architecture in the 2018/2019 academic year, http://wbia.pollub.pl/files/1/content/files/dydaktyka/program_studiow/Sylabusy_A1.pdf (Access: 30 April 2021).
- [3] Celadyn W., Controversy over the visions of the architectural profession. *World Trans. on Engng. and Technol. Educ.*, 2019, 17, 1, 71–75.
- [4] Current study program for Faculty of Construction and Architecture of the Lublin University of Technology.
- [5] Curriculum for architecture studies at the University of Applied Sciences in Nysa, first cycle studies, practical profile, academic year 2017/2018, http://www.pwsz.nysa.pl/dwm/pliki/katalog/program_ksztalcenia_arch_2017_2018.pdf (Access: 26 April 2021).
- [6] Hewitt M.A., *Draw in Order to See: A Cognitive History of Architectural Design*, Oro Editions, 2020.
- [7] Korbel W., Changes in Poland that influence architectural education and access to the profession, *World Trans. on Engng. and Technol. Educ.*, 2020, 18, 3, 264–271.
- [8] Koszewski K., *Projektowanie Zawodu* (Eng. Profession Design), Zawód: Architekt 75 (2020), online source: http://www.zawod-architekt.pl/pokaz/projektowanie_zawodu,616/ (Access: 30 April 2021).
- [9] Letter from the National Council of the Polish Chamber of Architects (2018), online source: http://www.izbaarchitektow.pl/pliki/wych_056_KRIA_2018.pdf (in Polish) (Access: 30 April 2021).
- [10] Mika P., Project realization for teaching building materials – a case study, *World Trans. on Engng. and Technol. Educ.*, 2020, 18, 3, 318–323.
- [11] Nyka L., Bridging the gap between architectural and environmental engineering education in the context of climate change. *World Transactions on Engineering and Technology Education*, 2019, 17, 2, 204–209.
- [12] Regulation of the Ministry of Science and Higher Education of 18 July 2019 on Standards of Training Preparatory Courses for the Profession of Architect Dz.U. 2019, item 1359 (in Polish).
- [13] Reinier de Graaf, *Four Walls and a Roof. The Complex Nature of a Simple Profession*, Harvard University Press, 2017.
- [14] Schumacher P., Crisis architectural education, 2019, online source: <https://www.dezeen.com/2019/07/09/patrik-schumacher-crisis-architectural-education/>, (Access: 26 June 2021).
- [15] Siedlecki B., Experience in technical education: the organization of practical construction training for students in a faculty of architecture, *World Trans. on Engng. and Technol. Educ.*, 2018, 16, 1, 65–69.
- [16] Study curriculum at the Faculty of Architecture of the Wrocław University of Technology, Architecture major, first cycle studies, academic year 2019/2020, online source: <https://wa.pwr.edu.pl/studenci/studia-i-stopnia-2/programy-studiow-2/architektura---studia-i-stopnia1/struktura-godzin> (Access: 26 April 2021).
- [17] Study curriculum at the Faculty of Architecture of the Wrocław University of Technology, Architecture major, first cycle studies, academic year 2020/2021, online source: <https://wa.pwr.edu.pl/studenci/studia-i-stopnia-2/programy-studiow-2/architektura---studia-i-stopnia1/struktura-godzin> (Access: 26 April 2021).