

## Design of residential buildings in architecture education

**Antoni Taraszkiewicz & Karolina Taraszkiewicz**

Gdańsk University of Technology  
Gdańsk, Poland

**ABSTRACT:** This article is based on an analysis of residential building designs made by students of the Faculty of Architecture at Gdańsk University of Technology (FA-GUT), Poland, and on the results of a survey conducted among these students. The purpose of the survey was to verify the broad, interdisciplinary knowledge of the students required in preparation for taking up design issues, as well as their ability to use this knowledge in the design of residential buildings. When examining these issues, particular emphasis was placed on the possibility of creating methods of architectural education that would allow today's students and future engineers to be appropriately trained, and thus become aware of the need to understand construction requirements, functional systems and their flexibility, principles of universal design and proxemics, economics of construction and use, energy efficiency and environmental protection, as well as psychological and spiritual needs of potential residents and other users. Respect for the context of the place also needs to be developed, and creative thinking and searching for architectural beauty encouraged and facilitated.

### INTRODUCTION

One of the basic elements in the process of teaching architectural design is teaching the design of residential buildings. In almost all architectural colleges in the world there are chairs, established or personal in recognition of one's expertise, dealing with the subject of residential buildings, as well as lectures and design exercises on this subject. Of course, there is nothing surprising in this, because a considerable number of the buildings erected in developed countries are residential buildings. For example, according to the data of the Polish Central Statistical Office, out of the total usable space built in Poland in 2021, residential construction accounted for as much as 60.7% [1].

However, this commonness of residential architecture and its closeness, comprehensibility and, in a sense, functional obviousness to every human being means that in many architecture schools, including the Faculty of Architecture at Gdańsk University of Technology (FA-GUT), Poland, the teaching of the design of residential buildings is incorrectly regarded as an easy subject that does not require prior, interdisciplinary preparation of students. Therefore, courses on the design of residential buildings take place in the first semesters, usually in the 3rd and 4th semesters of the first-degree programme.

Teaching the architectural design of residential buildings most often begins with the design of a single-family house. Later, it is continued in the next semester through the design of a multi-family building. An analysis of student designs made in the FA-GUT showed that the designs of single-family residential buildings with a small cubature and only a residential function usually do not pose too many problems for students (especially at the level of creating an architectural form and basic functional systems), allowing them to focus on searching for a certain individuality or personalisation of the solutions [2], which is demonstrated in Figure 1.

Designs of multi-family residential buildings with a large cubature and numerous accompanying functions, as well as an extensive area development programme pose a bit more difficulty, especially at the functional level. At the level of spatial solutions, however, these projects also allow students to create interesting architectural forms (see Figure 2).

The real problems arise when the design must enter into extremely important issues in housing construction, regarding the actual construction of buildings, economics of construction and use, energy efficiency and environmental protection, as well as the principles of universal design and proxemics. This causes many problems for students and shows their unpreparedness to take up design issues that require extensive, interdisciplinary knowledge.

Contemporary residential architecture must be much more than just an interesting form with a properly solved functional layout. It must be a human-scale, easily accessible part of its environment, provide warmth and, if necessary, coolness, sunlight and shade, be a shelter, and also a place for work and rest, a space for activity that determines the meaning of life.

It must be an idea transformed into a permanent architectural form. Contemporary residential architecture also requires pro-ecological solutions, functional accuracy and flexibility, durability, energy efficiency and economic efficiency. This architecture shows respect for the context of the place, respect for the past, and prefers contemporary creative thought over imitative and worthless reproductions of the past [3].



Figure 1: Design of a single-family house by student J. Laskowska (teacher: K. Taraszkievicz).



Figure 2: Design of a multi-family house by students K. Bartos and J. Naczke (teacher: K. Taraszkievicz).

One must also keep in mind that one of the greatest challenges of today is the fight against climate change. Due to this enormous threat, in today's times, architects are required to create architecture consistent with the idea of sustainable development, i.e. activities characterised by the highest degree of responsibility towards the natural environment and society. This is, of course, a question of moral responsibility for the consequences of design decisions for humans and natural systems, and for their coexistence. This means that contemporary designers need to respect ethics and demonstrate a system of values that is friendly to people and their environment. Students of architecture faculties - future engineers and

designers - must familiarise themselves with this system before they start such important undertakings as residential building designs.

## DESIGN OF RESIDENTIAL BUILDINGS - DISCUSSION

The design of residential buildings, for obvious reasons, has been a concern of many builders and architects throughout history, and the subject of many treatises and architectural theories. Of course, at the beginning, these theories focussed mainly on issues of purely construction and utility; however, over time, such as in Vitruvius' theory, apart from durability and usefulness of solutions, they also incorporated other important elements, such as, for example, beauty [4].

Over the centuries, all the great artists formulated their own theories of architecture, and rarely used the existing theories that had been left to them by past generations. The concept of *architecture* was understood differently by Plato or Vitruvius or by Leon Battista Alberti, who created the theory of classical architecture in the modern era. It was also seen differently by the founders of the modern movement, led by Le Corbusier, who attached particular importance to the residential function of architecture [5]. In the multitude of definitions and theories, there were also those that leaned towards the belief that the concept of architecture is possibly undefinable, referring to it as an art form that is constantly developing, alive and, most importantly, responding to contemporary challenges. This is how architecture, including residential architecture, was understood by such giants of contemporary architecture as Frank Lloyd Wright [6], Le Corbusier [7], Alvar Alto [8] and Zaha Hadid [9].

Today, in a dynamically changing reality, after a radical re-evaluation of all concepts, the earlier guidelines for creating an architectural work are no longer sufficient - despite numerous attempts to restore them to the main role and despite the enormous respect that contemporary architects still have for the intellectual achievements of outstanding thinkers and creators of the past. The ideas of Heidegger [10], Giedion [11] and Norberg-Schulz [12] opened up many possibilities for a new look at architectural creativity, and the measure of its value and artistry refers not only to the physical shape, but also to the search for answers to the question that is so important today:

*How in the modern world, in a constantly transformed environment, can a person keep their own identity, find their place, find their own existential space?*

Contemporary man, as viewed by Martin Heidegger, *is thrown* into human existence and searches for his own, intimate space [10]. His individuality requires that his immediate surroundings not only satisfy his basic living needs, but also provide him with positive, mental and spiritual experiences that are directed just at him. However, it is not only about satisfying the need to stay in a beautiful, architectural environment. Of course, architecture should be beautiful - whatever that term means today - after all, the canons of beauty have changed many times throughout history. Nowadays the concept of beauty would certainly not include the creation of architecture that was considered beautiful, for example, in the Middle Ages, not to mention how old masters, for example from the Baroque period, would react to contemporary, minimalist architecture.

Of course, the architecture perceived by users as beautiful has a very positive effect on their well-being, the sense of pleasure or even the joy of communing with the surrounding space. However, beauty itself is not the most important aspect to consider. The components of architecture that build this beauty seem to be more important. As early as the middle of the 20th Century, Steen Eiler Rasmussen wrote about the perception of architecture through such elements as solids and voids, contrasts, colour planes, scale, proportions, rhythm, texture, light, and even through the sense of hearing, hence *hearing architecture* [13]. This holistic approach to perceiving architecture with all the senses allows contemporary people to open up to various impressions, and through that perception - to reveal their real, individual psychological needs and their true essence. Architecture, especially residential architecture, when referred to as *my space and only my space* is loaded with emotions.

Housing architecture carries other, equally important, spiritual and emotional messages. Among many of them, the most important thing to mention is the desire to achieve a sense of freedom - the highest human value, which is the source of all democratic systems. The ideas proclaimed by Pericles [14] have survived for centuries and also apply to modern times and the living space that surrounds humans today, which may be perceived as giving a sense of freedom or - on the contrary - taking away this freedom [15]. It is not about symbols of freedom, but about shaping the space in such a way that gives all of its users, without exception, real and unlimited mental and physical freedom. Examples here are objects created in the spirit of universal design, as well as all architectural activities based on the principles of proxemics, especially taking into account the mutual influence of spatial relations between people and the material environment.

From the spirit of freedom arises another very important need of the human psyche - a sense of security, characterised by the lack of fear of the loss of intangible and material assets, such as independence, identity, honour, health, life, work or property. This necessity to introduce peace, order and harmony in one's own life is one of the basic existential needs of a human being. It is unfortunate, but not without reason that all over the world fenced and guarded enclaves of small residential buildings and large apartment buildings are being erected. Closed from external traffic, turned away from the environment, but open to the inner space, they offer comfortable living conditions in isolated apartments and are well-guarded against unwanted guests. This model of living, culturally alien to modern settlements, is gaining more and more

supporters, which is dictated by the overwhelming need to ensure the highest level of life safety for the residents, their family and inner circle [15].

Finally, a very important subject of environmental protection and ecology needs to be mentioned. The nearest future of residential architecture and architecture in general, must belong to the creators acting in accordance with the principles of sustainable development, its harmony and care for the surrounding space. In the era of climate change, and with the threat of a looming climate catastrophe, modern residential architecture is significantly focussed on energy-saving and all kinds of pro-ecological solutions [16]. The important factors in this context are: the use of renewable energy sources in housing construction, high insulation of external partitions, shape of the building body, and reduction or complete elimination of greenhouse gas emissions. All of the above should be supported by technical and installation infrastructure used in residential buildings.

It is also very important to eliminate all substances and building materials that are harmful to the environment and people, as well as ensuring proper land use, enabling the retention of rainwater, and the protection of soil and greenery. The provisions of the Leipzig Charter signed in 2007 by the member states of the European Union on the sustainable development of European cities are important here [17].

## DESIGN OF RESIDENTIAL BUILDINGS IN ARCHITECTURE EDUCATION

In order to check the level of students' preparation for design topics that require broad, interdisciplinary knowledge, a survey was conducted in the FA-GUT, among students of semester 3 and semester 4 of the first-degree programme, in the academic year 2021/2022. This survey covered students' recent designs for residential buildings and included nine questions for the students on whether the following factors were relevant to them:

1. Construction requirements, including durability of the construction.
2. Correctness of functional arrangement, including functional flexibility.
3. Principles of universal design and proxemics.
4. Economics of construction and use.
5. Energy-saving and environmental protection.
6. Users' mental and spiritual needs.
7. Context of the place.
8. Creative thinking instead of reproductive copying of patterns.
9. Search for architectural beauty.

For each of the questions, the students were to provide one of three answers: *Yes*, *No*, *Partially* (Table 1). The following core question was put forth to the students: *Were the following factors important to you during the execution of the semester designs?*

Figure 3: Example of a completed survey.

		Yes	No	Partially
1.	Construction requirements, including durability of the construction			X
2.	Correctness of functional arrangement, including functional flexibility	X		
3.	Principles of universal design and proxemics		X	
4.	Economics of construction and use		X	
5.	Energy-saving and environmental protection		X	
6.	Users' mental and spiritual needs	X		
7.	Context of the place	X		
8.	Creative thinking instead of reproductive copying of patterns			X
9.	Search for architectural beauty	X		

A total of 111 completed surveys were received. The answers to the survey questions fully confirmed the assumption presented in the introduction to this article regarding the lack of interdisciplinary preparation of early-year students to solve complex problems of residential architecture. The large number of respondents is a crucial factor in regard to the credibility of the findings.

The survey also showed that the students' knowledge of various issues varies greatly. There are issues the students have mastered very well and at the same time there are also some that they do not know enough about. The question with the highest number (as many as 90.9%) of answers confirming knowledge of the issue (*Yes*), was question 2, informing that in their designs of residential buildings, the students were guided by the pursuit of the correctness of functional systems, including functional flexibility. If one adds the *Partially* result (7.2%) to the *Yes* response, the resulting 98.1% is very satisfactory.

Also, a significant number of affirmative answers (86.5% each) were reported for question 7 and question 9, demonstrating that the students took into account the context of the place and the search for architectural beauty in their projects. Including the *Partially* answers, which constitute 12.6% each, the authors also obtained a satisfactory result of 99.1%.

The mental and spiritual needs of the users of residential buildings (question 6) were taken into account in the projects by 80.2% of the students, and 17.1% of the students declared that they partially covered these needs.

On the other hand, the students' answers to the remaining questions of the survey gave a much less optimistic picture. Only 61.3% of the students - future engineers in the design of residential buildings - were guided by the requirements of a constructional nature (question 1), which is quite amazing for students at a technical university; and only 52.3% of the students - future creators of architecture - declared that they prefer creative ideas over reproductive copying of patterns (question 8).

However, the answers to question 4 and question 5 are the most worrying, especially at the time of the climate crisis. The fact that the students did not sufficiently take into account the principles of building economics in their design work (only 35.1% of the *Yes* answers), as well as energy-saving and environmental protection measures (43.2% of the *Yes* answers) testifies to a lack of knowledge or interest in the greatest challenge of the time, which is undoubtedly the protection of the planet and its natural resources.

It is also rather saddening that the least number of affirmative answers (only 21.6%) was given to question 3, concerning the incorporation of universal design principles and proxemics in housing design. Today, shaping the surrounding space based on the principles of functionality and accessibility for all users not only brings obvious benefits to all members of society, but also testifies to the level of its civilisational development.

## CONCLUSIONS

The analysis of the students' designs and the results of the student questionnaire clearly indicate that the students of the early semesters, due to the short period of their studies, do not yet possess the adequate interdisciplinary knowledge to enable them to properly and comprehensively solve design problems concerning residential architecture. While they are familiar with some issues, such as the functionality of housing, taking into account the context of a place, and the search for architectural beauty, they have little or no knowledge of many other issues.

Therefore, the authors recommend that in the faculties of architecture, designs concerning the housing function should be carried out by students of the highest semesters; and that during their studies there should be intensive teaching of construction, the economics of building construction and use, energy efficiency and environmental protection, as well as the principles of universal design and proxemics. Particular importance should be attached to educating students on the concept of sustainable development, and also on the technical methods of implementing these ideas.

These issues should be an especially important part of the curricula at the faculties of architecture, giving students - future architectural engineers - the opportunity to fully master all of the issues, and so making it possible for them to create residential architecture that meets the challenges of modern times and satisfies all of the current residential needs of humanity.

These issues are particularly important in the FA-GUT context, where the survey had been conducted. Once the curricula of the architecture faculties have been strengthened to include the above-mentioned issues and residential design has been moved to the highest semesters of study, a further survey of students' knowledge and skills should be carried out using an analysis of student projects and the same survey as presented in this article. The aim of this second study would be to determine how changes in the curriculum have improved students' mastery of an interdisciplinary approach to residential design.

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