

Discovering others and transforming the world together - the effect of an innovative attitude in sustainable design

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ABSTRACT: In this article, the author presents the results of the scientific and teaching activities in the Department of Architectural and Urban Theory and Design (DAUTD) at Kielce University of Technology (KUT), Poland, which are part of the work on the assumptions of sustainable urban development carried out within the newly-established universal design laboratory. It presents students' architectural concepts that combine a range of design and simulation approaches that have been experimentally tested, and are aimed at implementing the concept of an accessible and socially, spatially, economically and environmentally coherent city. It shows a broader view of the issue understood as a *process of growth and change*, by increasing the range of architectural and urban approaches that promote sustainable solutions and foster innovation. It draws attention to the need to implement the idea of social inclusion and to improve the quality of life of people with disabilities, and the need to continuously raise awareness among young architects about sustainable design (SD) and universal design (UD).

Keywords: Universal design, disability, sustainable architecture, innovation, accessibility hub

INTRODUCTION

The second decade of the 21st Century has brought an increased awareness of architectural and urban design of sustainable - universal buildings and spaces in response to the most current needs of contemporary society. At the same time, due to the progressive negative spatial, functional and social changes taking place in many European cities, including those in Poland [1], out of respect for the surroundings, the natural environment and every user of space, there is an urgent need to design properly organised, safe and friendly places, and attractive, functional and aesthetically arranged interiors. This is one of the most current reasons for seeking solutions that can counteract the negative effects of this situation, and for the need to reorganise the modern urban environment from a disorderly chaos into an orderly and fully accessible social space. By design, such structures should be provided with various types of services, modern and attractive spatial forms, places for recreation, and should be largely covered with vegetation to increase biologically active areas and enrich the local ecosystem. Only then will all this system be conducive to human health, experience of an appropriate aesthetic quality, identification of the place and the need to find one's own integrity.

Purpose and Scope

The purpose of this article is to present the results of the scientific and teaching activities of the Department of Architectural and Urban Theory and Design (DAUTD) in the Faculty of Civil Engineering and Architecture at Kielce University of Technology (KUT), Kielce, Poland, which are part of the work on the assumptions of sustainable urban development carried out within the newly-established modern universal design laboratory - *Centre for Knowledge on Accessibility*, including the outstanding student designs prepared on the basis of this model. The designs focused on the implementation of the concept of an accessible and socially, spatially, economically and environmentally coherent city.

In this context, it is particularly important to: 1) take a broader view of the issue understood as a *process of growth and change* that ensures that current needs are met and that future generations are not limited in their ability to meet their own needs [2]; 2) search for an integrated order - in a city that meets the needs of members of today's and future generations of all ages; 3) make the idea of social inclusion and improvement of the quality of life of people with disabilities more realistic; and 4) draw attention to the need for continuous implementation of the principles of sustainable design (SD) and universal design (UD) in architectural and urban design, and continuously raise awareness of SD and UD among young architects.

Along with the idea of sustainable development and in response to the growing interest in the quality of life in the environment where people live and function, the priorities in the design of architectural and urban space are convenience and safety of users, contact with nature and universal accessibility, among other things. According to the universal design concept, it is particularly important to consider the full range of the diversity of users, based on their physical, perceptual and cognitive capabilities.

There is an extensive literature on sustainable development. However, there are still no current studies that link the issues of a sustainable city with architectural and urban planning problems and solutions. The need for these processes has already been emphasised in the Brundtland Report [3]. However, despite years of research, the multifaceted group of discussions mainly includes the concepts of green architecture, eco-architecture [4], eco-city [5], compact city and smart-city [6].

There are also few publications relating to the education of architectural and urban designers [7][8] despite an extensive literature on universal design and broad guidelines for barrier-free design.

In Poland, issues related to ensuring accessibility are regulated by the Act of 2019 on Providing Accessibility to People with Special Needs [9], which refers to the theory of universal design (UD) as a special philosophy that applies to the provision of equal access to all users and, by addressing the needs of individuals, it benefits the community as a whole [10].

The question of a universal design concept pioneered by Goldsmith [11] was developed by Ronald Mace as early as the early 1970s. In 1997, at North Carolina State University, USA, he conducted pioneering research with a team of architects, engineers and scientists, and formulated seven principles of universal design (UD) that constitute a starting point for shaping architectural structures [12].

The current official definition of UD, found in the 2006 United Nations Convention, is designing products, environments, programmes and services so that they are usable by all people, to the greatest extent possible, without the need for adaptation or specialised design [10].

UD is also associated with design that refers to the design for all (DfA) concept, which provides for diversity, social inclusion and equality. It aims to give all people equal opportunities to participate in all aspects of the life of society [13].

SD AND UD IN ARCHITECTURAL EDUCATION

The conceptual assumptions of the Department of Architectural and Urban Theory and Design (DAUTD) in the Faculty of Civil Engineering and Architecture at Kielce University of Technology (KUT), Poland, are closely related to teaching and research activities. They are focused on the implementation of the concept of an accessible and socially, spatially, economically and environmentally coherent city. The social dimension focuses on participation and community-sensitive projects. The ecological dimension, on the other hand, is aimed at environmental protection and the development of innovative solutions that meet the standards of sustainable architecture.

As part of a multi-stage and complex learning process, young people become the creators of sustainable architectural and urban spaces, and authors of their own lives. Within the framework of the curriculum - the graduation architectural and urban design block, the ideas and principles of SD and UD are implemented, and activities aimed at adapting the environment and minimising the experience of limitations resulting from individual states of disability are introduced through the transfer of theoretical knowledge and practical design exercises, active participation of students and teachers in national and international scientific conferences and workshops, participation in specialised seminars and construction industry fairs, as well as participation in scientific works and publications.

Methods

The proprietary teaching method used included in-depth analyses of innovative architecture with pro-environmental and pro-social potential. A flexible approach and unlimited creative freedom were preferred. It consisted of multifaceted implementation of SD and UD design in the educational process in the theoretical, empathy-based and empirical field - focused not only on the visual aspect of architecture, but also on the direct multisensory experience of various types of disability and its simulations carried out at the building and urban space scales.

The key things in the teaching and experiments were:

- Identification of the most important principles that should guide designers at the stage of conceptual, construction and detailed design - each time taking into account the needs of people with functional limitations.
- Selection of a design direction that does not single out people with disabilities in any way, but makes newly constructed buildings and spaces accessible to all, in particular:

- the issue of accessibility and usability of newly created public, social and semi-private spaces, buildings and products;
 - the way they are designed: accessible and convenient to use for the maximum number of users;
 - improvement of the living and functioning conditions for people with special needs: phenomenological context, intentional relationship - providing an opportunity to recognise the needs, expectations and functioning of people with special needs;
 - analysing the various aspects of individuated functioning: aspects of limited human fitness, which enabled a holistic view of people with disabilities in a comprehensive picture of their biological, psychological and social functioning.
- Sensitisation, empathy, emphasising the importance and role of all kinds of solutions in architectural and urban design that:
 - allow to overcome architectural barriers;
 - facilitate the entire society's functioning in spaces and buildings.

CONTEXT OF PERSONAL EXPERIENCE - SIMULATIONS OF DISEASES AND DEFECTS

In order to make living conditions more realistic and create an accessible, inclusive social space, in addition to imparting sound knowledge, it has become crucial in design-related teaching and research to carefully identify the needs, capabilities and limitations of people with various disabilities on an individual basis. Figure 1 demonstrates some workshop experiments conducted with students in safe laboratory conditions.



Figure 1: Workshop experiments with students conducted in safe laboratory conditions - Centre for Knowledge on Accessibility, KUT, 2022 (photographs: Joanna Gil-Mastalerczyk and Rafał Głogowski).

Within the framework of the newly created laboratory functioning at the DAUTD, named: *Centre for Knowledge on Accessibility* - a unit supporting the application and dissemination of the principles of universal design in the area of higher education - analyses were conducted with the participation of students on various aspects of individual functioning of people with disabilities. The research involved an empirical identification of people's sense of identity in connection with the disabilities they have. The young people recognised disability as a special predisposition to cause difficulties in a person's life, but also as a result of an experienced stigma, marginalisation, distancing, social exclusion, and even a sense of inefficiency in life [14][15].

Specialised laboratory equipment has become a valuable tool for clarifying these issues. It included, in particular, support and auxiliary communication equipment, simulators for various types of defects and diseases, and a GERonTologic simulator (GERT) suit, which enable the simulation of a variety of scenarios reflecting the conditions in which people with various disabilities function (Figure 1). By playing the role of people with disabilities, the students were given the chance to realistically test and experience first-hand the needs of elderly people. Using the appropriate equipment, they tested the structures and spaces that people with disabilities use in their daily lives.

The pilot experiments involved students and a team of instructors who shared their research experience and jointly controlled all stages of the activities undertaken. As a result of extensive activities, the students accurately identified the causes and type of motion conditions of people with disabilities. They learned how building users with various disabilities could move and operate freely in the built environment.

In the academic training of professionals, the experience of disability has generated unforgettable experiences and many positive values. It has triggered creative design activities and provided an important impetus in the creation of an environment that provides accessible living conditions for all.

SUSTAINABLE, INNOVATIVE SOLUTIONS IN STUDENTS' DESIGNS

In the context of global data collected in the European Health Interview Survey (EHIS) [16], which indicate an ever-increasing number of people with various types of limitations and an increase in the retirement age (over 60) population, especially in developed countries, the UD and SD design in architecture and urban planning is becoming increasingly important. In this context, multifaceted professional education - based on sustainable design - at all levels of education becomes essential.

The effects of the activities undertaken at the DAUTD are illustrated by selected graduation designs prepared by Master's degree programme students in the academic year 2021/2022 (Figure 2 and Figure 3). As part of the scientific and teaching activities combined with study trips and workshops, using the knowledge and experience of leading experts from Polish and foreign universities, original conceptual solutions and innovative products were developed - based on the principles of universal design.

Innovative Startup Centre

The first structure presented, the *Innovative Startup Centre* (Figure 2) - an office building in the aspect of sustainable design - was located in the centre of the city of Kielce (Świętokrzyskie Province, Poland), as a place where unparalleled infrastructure and a comprehensive ecosystem enable high-tech, innovative and creative businesses to grow and flourish. It was designed as a bridge connecting universities, research institutes, manufacturers and businesses.

The complex is characterised by a well-developed transportation network and unconventional architecture. The ellipsoidal projection was preserved as a free plan devoid of permanent partitions in the form of massive walls. Designing the facility with such assumptions observed, allowed the optimal use of the space of each floor. All vertical circulation, which comprised elevators with escape stairs, as well as ducts and internal systems, was placed in the central part of the building. As for parking capacity, a multi-level garage with spaces for people with disabilities and bicycle users, with a special area with facilities, has been designed.

Panels with design-specific proprietary shapes were used for the façade with dynamically changing geometry. The building's original kinetic architecture is perfectly in line with future architectural trends. Its innovative form allows for experimentation and represents an evolutionary step forward and a departure from constraints imposed on form. It should be emphasised that kinetic architecture is a perfect example of sustainable architecture. Kinetic façades provide greater comfort to users by eliminating excessive sunlight and simultaneously harvesting solar energy. With the help of such solutions, buildings are cost-free in terms of operation and enable the process of self-sufficiency.

The building fully implements the principles of universal design. They were applied at every level of design, including meeting basic user needs, functional needs and social needs. The designed building is also a kind of complement to the concept of a compact city. Its residents will be able to find jobs and take advantage of additional services in close proximity.

The innovations outlined are not the only elements conducive to an ecological order and the concept of sustainable development. In addition to a sustainable wind-powered façade that provides protection from the sun, effective and

impressive light diffusion, the building has a rainwater recovery system, photovoltaic panels and a ground source heat pump. The common areas of the complex are equipped with LED lighting panels integrated with motion sensors. The use of the above technological solutions, combined with the developed façade system, can guarantee obtaining a Building Research Establishment Environmental Assessment Method (BREEAM) certificate at the *excellent level*.



Figure 2: *Innovative Startup Centre* - an office building in the aspect of sustainable design. Conceptual design, author: Anna Raczyńska, supervisor: Joanna Gil-Mastalerczyk.

Life Centre

The second design presents a multi-functional high-rise building, named: *Life Centre* (Figure 3), located on an abandoned and undeveloped plot of land in the city centre of Gliwice (Śląskie Province, Poland).

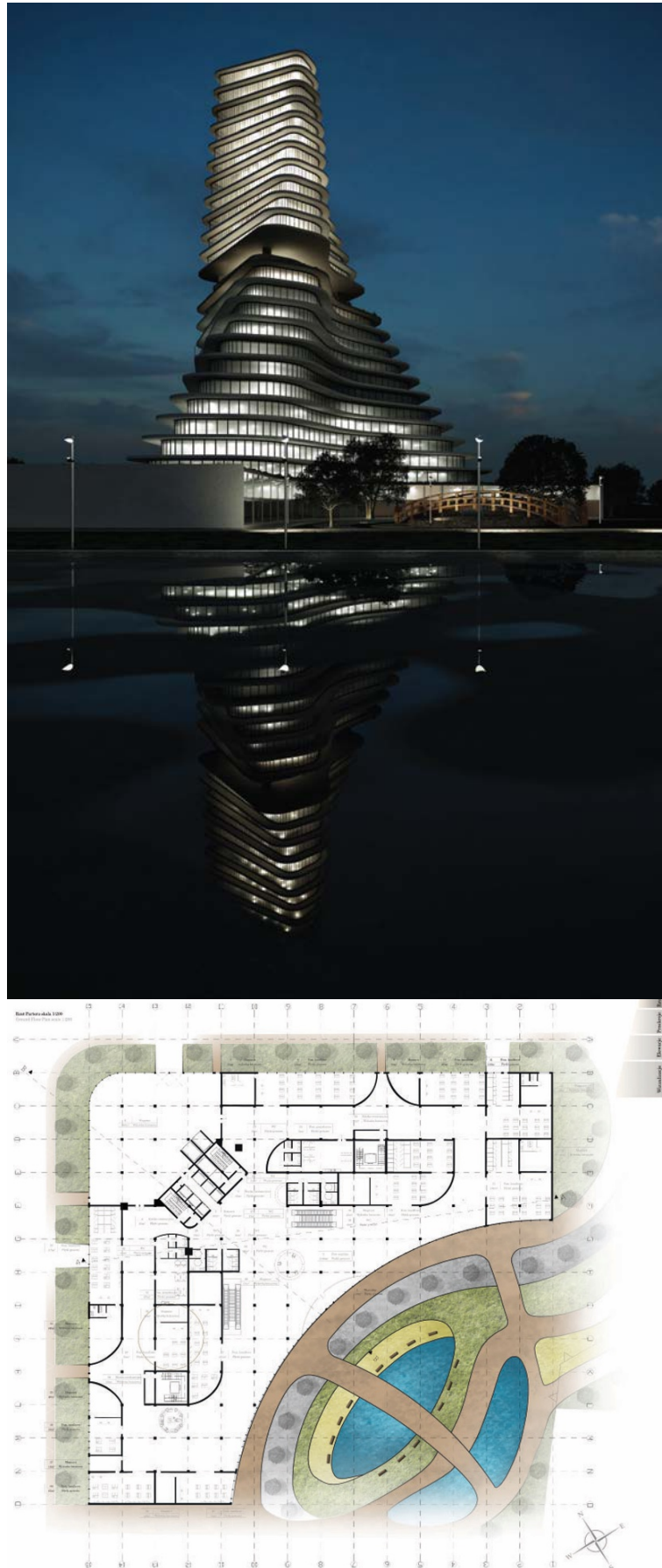


Figure 3: *Life Centre* - a commercial and residential high-rise building. Conceptual design, author: Martyna Wójcicka, supervisor: Joanna Gil-Mastalerczyk. A proprietary visualisation of the high-rise building, office interior.

The sizable dynamic building is characterised by a bold form devoid of traditional ornamentation. Its 28 residential and commercial floors extend to maximise the height of the building. The architectural concept, with its multi-layered geometry, gives the building a dynamic feel and refers in shape to a pyramid, inspired by the concept of a fifteen-minute city. For this reason, the building is designed with all the basic functions associated with the system of human needs, such as work, home and rest. The most important social functions, i.e. the residential ones, were located at the very top.

The attractive shape with an original curvature houses a rich functional structure, which includes retail space, work and leisure areas, places for integration and contact with nature, office, catering, service, and recreational parts and residential areas. A green garden - which is the heart of the building and a common area for relaxation and leisure accessible to all users - was proposed in the middle of the building's height and at its centre. A two-floor parking lot with 250 parking spaces, including 15 for people with disabilities, and an area for bikers with facilities, was located under the plot.

The building was created according to the model of a fifteen-minute city that meets the needs and expectations of today's demanding society, such as contact with nature, the need to belong, attractions and entertainment, among other things. The design incorporates elements of sustainable design with eco-friendly solutions, including the introduction of green roofs and green viewing terraces, adaptation of the building for solar energy harvesting and grey water recovery systems. The shape of the building resembles a spiral filled with nature in the form of publicly accessible abundant greenery. On the podium - the garden - are a variety of plants that form the nucleus around which the office lobby and the retail and restaurant/catering areas are organised.

The angled building shape serves to increase access to natural light and is an interesting concept introduced into urban structures. Plants used in the building create their own environment, inhabited by various birds and insects. This created a living space, where the landscape is changed with the seasons by the plants and animals. As a result, the building helps restore the city's microclimate and filters fine particles in the urban environment. The plants produce moisture, absorb carbon dioxide, produce oxygen and protect against excessive sunlight and noise.

DISCUSSION

Universal design creates opportunities to improve the quality of life for the society as a whole and for those who experience limitations in their functioning, due to disabilities [17].

The concepts presented, which are fully relevant to the current times, were designed in accordance with the principles of universal design that are based on the satisfaction of the social, functional and cognitive needs of building users. In modern times, this is a particularly important aspect and responsible approach to the design of spaces for work and functioning of people. A well-designed service building, like the buildings presented herein, enables full participation and functioning, attracts the user to the workplace, integrates and creates conditions for attractive leisure activities.

Designers should always be aware of this, as well as should exceed the limitations of traditional design. Therefore, in the process of architectural and urban design, in addition to the individual needs of users, lifestyles and work, it is important to analyse a wide range of variables, such as the location and immediate surroundings of the building, the natural environment and energy resources.

In conclusion, the architectural concepts presented herein combine a number of design and simulation approaches experimentally tested on various types of buildings and spaces, with the assumptions verified with a group of experts in architectural and urban design and structural solutions.

SUMMARY AND CONCLUSIONS

The teaching and research approach of the DAUTD allowed to develop comprehensive solutions that best meet a range of SD and UD requirements, as well as successful innovations. This will certainly influence the future design practice of young architects-urban planners, as well as facilitate the strengthening of scientific capacity.

In conclusion, it should be said that in achieving sustainable urban development, it is very important to look at the design from multiple perspectives and to link many issues, such as the individual needs of all users at different periods of their lives and at all times, the market demand and technological feasibility of the design. Only then can the desired effect be achieved. Therefore, it is essential to approach the design process holistically and to take a broader view of the issues raised by increasing the range of architectural and urban planning solutions that:

- Promote sustainable solutions and support innovation, as well as dissemination and diffusion of environmentally friendly technologies that are of key importance to development [18][19];
- Pay special attention to the needs of vulnerable groups, people with disabilities and the elderly;
- Provide easy and widespread access to safe and inclusive green spaces and public space;
- Increase the efficiency of resource use and the use of clean and environmentally friendly technologies and production processes; and
- Integrate economic, environmental and social dimensions.

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BIOGRAPHY



Joanna Gil-Mastalerczyk is a graduate of the Faculty of Architecture at Cracow University of Technology (FA-CUT), Kraków, Poland, where she graduated in the field of conservation of monuments of architecture and urban planning in 2001. Further, she defended her doctorate and habilitation in 2013 and 2019, respectively at the same institution. She also obtained a diploma from the Royal Institute of British Architects (RIBA) in 2020, *with first place*. She is a practicing architect and professor at Kielce University of Technology (KUT), Poland. From 2021, she has been Head of the Department of Theory and Architectural and Urban Design at the KUT's Faculty of Civil Engineering and Architecture. In the field of scientific research, she is the author and co-author of numerous publications and papers presented at international conferences in the field of history of contemporary architecture, spatial and architectural urbanisation, spatial planning, conservation of architectural monuments and urban planning.

She has architectural qualifications and extensive experience in architectural and construction administration structures. In the years between 2003 and 2013, she held various managerial positions at the Department of Architecture, Construction, Investments and Renovation of the District Office in Kraków, Poland, the Institute of Spatial and Municipal Management Branch in Kraków, Poland, as well as leading architectural design studios and construction companies.