MULTIFACETED RESEARCH IN ARCHITECTURE

Editor **Beata Komar**

VOLUME V

THE ARCHITECTURE OF CRISIS

Editor **Aleksandra Witeczek**

WYDAWNICTWO POLITECHNIKI ŚLĄSKIEJ
GLIWICE 2022

MONOGRAFIA

MULTIFACETED RESEARCH IN ARCHITECTURE

Editor **Beata Komar**

VOLUME V

THE ARCHITECTURE OF CRISIS

Editor
Aleksandra Witeczek

WYDAWNICTWO POLITECHNIKI ŚLĄSKIEJ
GLIWICE 2022
UIW 48600

Wydano za zgodą
Rektora Politechniki Śląskiej

Publikacja współfinansowana ze środków budżetu Województwa Śląskiego
Publication co-financed by budget of the Silesian Voivodeship

Silesian Voivodeship

The honorary patronage
of the Marshal of the Silesian Voivodeship
Jakub Chełstowski

Redakcja techniczna
Ewa TENEROWICZ

Projekt okładki
Karolina CHODURA

ISBN 978-83-7880-844-2

TABLE OF CONTENTS

SPIS TREŚCI

Aleksandra WITECZEK[1]

PRELIMINARY WORD OF THE EDITOR OF THE MONOGRAPH

THE ARCHITECTURE OF CRISIS – THE SPACE FOR CHANGES

The only thing that is constant in life is change.
Heraclitus of Ephesus

The space built around us has always been subject to transformations. All changes have an impact on our direct surroundings. The pace and scope of such changes definitely influence the ways and methods we are using to keep up with the contemporary world and shape our space accordingly. The strongest generators of transformation are social and economic crises as well as military conflicts causing the collapse of the previous pillars of development in many fields. Sometimes, the changes are so drastic that the necessity of adjustment turns the widely-used patterns, notions and clichés upside down. The word 'crisis' is spoken more and more clearly against a background of progressing and irreversible climate changes of the past two decades.

The term 'crisis' comes from the old Greek κρίσις 'crisis' and means in a general sense: *choice, deciding, struggle, fight which requires action under time pressure*. A worldwide crisis, encompassing all aspects of life, simultaneously generates change and becomes a driving force behind the search for new solutions. At the same time, the subject of death and pandemic visions of the world have always been used by artists as an exceptionally resounding topic, both in art and architecture. Among architectural solutions of the time of crisis there appear some temporary means of solving problems. However, over the course of time, some of them (not only positive ones) may become standard solutions. An example of such changes might be the speed limit introduced in the USA due to the fuel crisis, and not, as you may think, because of the desire to increase traffic safety.

All extensive pandemics sweeping all over the world throughout the centuries disrupted the functioning of cities. Yet some modifications implemented during the times of turmoil have remained in place and become a permanent part of the

[1] Dr inż. arch., Politechnika Śląska, Wydział Architektury, Katedra Projektowania Architektury Mieszkaniowej i Użyteczności Publicznej, aleksandra.witeczek@polsl.pl

cityscape. Temporary burial sites located within the city walls constituted an integral element of the urban landscape and blended with the urban tissue, becoming sites for church fetes, mystery or miracle plays, or the dwelling places for the poorest. It was only in the 19th century, in Europe, that a radical change in the perception of death and cemeteries occurred. They became a taboo subject – the burial sites were driven away outside the city walls. Even today, in the countries of Asia and South America, cemeteries constitute an integral part of the city – the background of social events. On the other hand, there are places of temporal burial, which have been permanently incorporated into the contemporary urban tissue. These are small cemeteries in Bosnia and Herzegovina, for instance, the side football pitch of the Koševo Stadium in Sarajevo, which only 10 years before was the arena of the opening of Winter Olympic Games in 1984.

For two years, we have been observing considerable changes in the organization of the space built around us due to the pandemic caused by the SARS-CoV-2 virus. These changes result directly from the necessity of keeping physical distance in public spaces, and from the need for re-organization of flats and houses due to remote working or e-learning.

Limitation of the presence of a big number of people in public spaces, such as: means of transport, shops, restaurants, and public offices, resulted in the reorganization of their spatial and functional layouts. The changes in the availability of certain zones to customers, lines marking the space assigned to one person – are elements that significantly affect our perception of the surrounding architecture. The pandemic has deepened the crisis connected with the surplus of office space, which existed even before the pandemic due to economic reasons and the saturation of the market in large cities. A new form of working appeared, the so-called *mobile office*, which enabled the reduction of work stations in the office by 10-50% due to the frequent absence of some employees. The new system made it possible to arrange desks in an alternating way and implement partitions between them to increase privacy and social distancing.

Our homes were subjected to the greatest challenge – the necessity of combining the living and recreational zones with the learning and working zones. The fact that several people had to work and learn remotely, often in a small space and at the same time, revealed the shortcomings of the functional system of the existing architectural solutions. To improve the quality of life, it was necessary to verify the existing structures with a view to their adaptation to the new reality and introduce thus new spaces combining elements of traditional living and contact with nature with parallel functioning in cyberspace.

The economic crisis and problems with natural resources availability, resulting in the increased prices for electric energy, have triggered and imposed new technological solutions in the scope of energy efficiency of heating and cooling devices. It has also had an impact on the modification of functional solutions, multi-functionality of rooms and new zoning. The changes on the building market, connected with the lack of construction materials, have lead to the wider use of post-recycling materials and the application of more easily available materials. The search for solutions in building engineering which provide more affordable, sustainable materials and building technologies as well as economical use of such objects seems to be the only right way at the time of recession.

The monograph we are passing on to you was elaborated at a special time. The pandemic vision of the contemporary world has set different priorities and changed the so-far patterns of functioning of the society, economy, systems of values on which the world known to us was built. Simultaneously, the first alterations of the built space are already visible. They have been brought about by present-day events. Time will show whether they remain temporary or permanent changes.

Aleksandra WITECZEK[2]

SŁOWO WSTĘPNE REDAKTORA MONOGRAFII

ARCHITEKTURA KRYZYSU – PRZESTRZEŃ ZMIANY

Jedyną stałą rzeczą w życiu jest zmiana.
Heraklit z Efezu

Przestrzeń zbudowana wokół nas zawsze ulegała przemianom. Wszelkie zmiany oddziałują na nasze bezpośrednie otoczenie, a ich tempo oraz zasięg mają zdecydowany wpływ na sposób, w jaki próbujemy nadążać z kształtowaniem naszej przestrzeni. Najsilniejszymi generatorami zmian są kryzysy społeczne i gospodarcze oraz konflikty zbrojne, powodujące załamanie się dotychczasowych filarów rozwoju w różnych dziedzinach. Czasem są to zmiany tak drastyczne, że potrzeba dostosowania się wywraca utarte schematy. Na tle postępujących i nieodwracalnych zmian klimatycznych ostatnich dwóch dekad hasło „kryzys" wybrzmiewa nie tylko częściej, lecz także coraz wyraźniej.

Termin „kryzys" pochodzi z greckiego stgr. κρίσις „*krisis*" i *oznacza, w sensie ogólnym, wybór, decydowanie, zmaganie się, walkę, w której konieczne jest działanie pod presją czasu*. Ogólnoświatowy i ogarniający wszystkie aspekty życia kryzys jest jednocześnie generatorem zmian, narzędziem napędzającym poszukiwanie nowych rozwiązań. Równocześnie tematyka śmierci, pandemiczne wizje świata nieodłącznie wykorzystywane były przez artystów jako temat niezwykle nośny nie tylko w architekturze, lecz także w sztuce. Wśród rozwiązań architektury czasu kryzysu pojawiają się rozwiązania tymczasowe, lecz z biegiem czasu część z nich, nie tylko tych pozytywnych, staje się rozwiązaniami standardowymi. Wśród takich rozwiązań jest między innymi ograniczenie prędkości w USA związane z kryzysem paliwowym, a nie, jak można by się domyślać, ze zwiększeniem bezpieczeństwa.

Wielkie epidemie przetaczające się przez świat na przestrzeni dziejów powodowały zakłócenia w funkcjonowaniu miast. Jednak część wprowadzanych modyfikacji pozostawała na trwałe wpisana w sposób ich działania. Tymczasowe miejsca pochówków, zlokalizowane w ramach murów miejskich, przez stulecia stanowiły integralny element krajobrazu wielu miejscowości, wpisując się w tkankę miejską,

[2] Dr inż. arch., Politechnika Śląska, Wydział Architektury, Katedra Projektowania Architektury Mieszkaniowej i Użyteczności Publicznej, aleksandra.witeczek@polsl.pl

stanowiąc nierzadko miejsce odbywania się odpustów, misteriów, zamieszkania najuboższych. W Europie dopiero XIX wiek przyniósł zmianę w postrzeganiu cmentarzy i śmierci jako tematu tabu – miejsca pochówków wyprowadzone zostały poza obręb murów miejskich. Do teraz w krajach Ameryki Południowej i Azji cmentarze stanowią integralną częścią miasta, będąc tłem dla wydarzeń społecznych. Z kolei przykładem miejsc tymczasowych pochówków, które na trwałe wpisały się w tkankę współczesnych miast, są niewielkie cmentarze w Bośni i Hercegowinie, między innymi boisko boczne stadionu Koševo w Sarajewie, który zaledwie 10 lat wcześniej był areną otwarcia Zimowych Igrzysk Olimpijskich w roku 1984.

Od dwóch lat obserwujemy wyraźne zmiany w organizacji przestrzeni zbudowanej wokół nas, rozgrywane na tle pandemii wywołanej przez wirusa SARS-CoV-2. Zmian wynikających bezpośrednio z potrzeby zachowania dystansu społecznego w przestrzeniach użyteczności publicznej, a równocześnie przeorganizowania doświadczyła większość mieszkań i domów z uwagi na przeniesienie pracy oraz nauki w tryb zdalny.

Ograniczenia w liczbie osób przebywających jednocześnie w miejscach użyteczności publicznej, np. w komunikacji miejskiej, sklepach, restauracjach, urzędach, poskutkowały reorganizacją ich układów funkcjonalno-przestrzennych. Zmiany w strefach dostępności dla klientów, linie wyznaczające przestrzeń dla danej osoby to te elementy, które wpłynęły znacząco na odbiór otaczającej nas architektury. Pandemia pogłębiła kryzys związany z nadmiarem przestrzeni biurowych, wynikający z przyczyn ekonomicznych zapełnienia rynku, sygnalizowany jeszcze przed pandemią w dużych miastach. Pojawiła się nowa forma pracy, tzw. *biuro ruchome*, polegające na zmniejszeniu liczby stanowisk pracy o 10-50% z uwagi na częstą absencję części pracowników, co umożliwiło mijankowe rozstawienie biurek względem siebie i przegród między biurkami, aby zwiększyć prywatność.

Nasze mieszkania i domy zostały poddane najcięższej próbie – konieczności połączenia w ich wnętrzach strefy mieszkalnej, rekreacyjnej, miejsca pracy i nauki. Potrzeba pracy i nauki zdalnej kilku osób równocześnie, często na niewielkiej przestrzeni, ujawniła ich niedoskonałości funkcjonalne. Konieczna stała się weryfikacja istniejących struktur pod kątem możliwości ich adaptacji do nowej rzeczywistości, wprowadzenia stref łączących elementy tradycyjnego użytkowania, kontaktu z naturą oraz równoległego funkcjonowania w cyberprzestrzeni dla poprawy jakości życia.

Kryzys ekonomiczny oraz utrudnienia w zakresie dostępności surowców naturalnych, przez wzrost cen energii wymuszają inne rozwiązania techniczne dotyczące efektywności energetycznej urządzeń grzewczych i chłodniczych, ale też wpływają na modyfikację rozwiązań funkcjonalnych, wielofunkcyjności pomieszczeń

oraz ich strefowania. Zmiany na rynku budowlanym, związane z brakiem dostępności materiałów budowlanych, odbiją się w szerszym wykorzystaniu materiałów porecyclingowych, oraz zmianą rozwiązań budowlanych na te łatwiej dostępne. Poszukiwanie rozwiązań w budownictwie zapewniających tańsze i bardziej zrównoważone środowiskowo materiały i technologie budowy oraz ekonomiczne użytkowanie obiektów wydaje się jedyną słuszną drogą w czasie recesji.

Monografia, którą przekazujemy na Państwa ręce, powstała w czasie szczególnym. Pandemiczna wizja współczesnego świata przewartościowała dotychczasowe schematy funkcjonowania społeczeństw, gospodarek, systemów wartości, na których opierał się znany nam świat. Równocześnie zauważalne są już pierwsze zmiany w przestrzeni zbudowanej, wywołane przez aktualnie rozgrywające się wydarzenia. Czas pokaże, czy będą to zmiany jedynie tymczasowe.

Beata KUCHARCZYK-BRUS[3] Agata WYCIŚLOK[4]

ANALYSIS OF STATISTICAL DATA ON CONSTRUCTION IN THE CONTEXT OF CONSTRUCTION WASTE PROCESSING AND THE POSSIBILITY OF THEIR REUSE IN ARCHITECTURE

1. INTRODUCTION

Pursuant to the Waste Act of December 14, 2012, waste is “any substance or object that the holder discards, intends to discard or is required to discard” [1]. Of course, this definition also includes construction waste, the production of which is related to the erection of buildings, renovation, demolition, or even road investment. According to Eurostat data, more than 35% of waste generated in the European Union is construction waste [2], which makes it a sector that should be looked at more closely to look for circular solutions contributing to the reduction of the amount of wasted resources.

Contemporary design ideas related to the idea of sustainable development, as well as ecological problems related to the excessive production and consumption of goods, require a deeper reflection on the purposefulness of research and the implementation of the results of these studies, concerning the wider possibility of reusing used or dismantled building materials and elements. This phenomenon is not new, and - as can be observed on online platforms related to the sale of second-hand goods (e.g. Allegro, OLX) - the supply and demand for materials from disassembly show a growing tendency. This is a very good symptom resulting from both: economic reasons and the growing environmental awareness of citizens. Unfortunately, the phenomenon of the reuse of demolition materials in new investments concerns only small investors constructing with the so-called "on their own" system. The wider use of recycled materials requires both expert analyses allowing the used materials to be recycled, and high building culture during the demolition of buildings (more splitting than demolition).

The analysis of statistical data related to construction waste, and the observation of the method of their collection and disposal, make it necessary to take actions

[3] Politechnika Śląska, Wydział Architektury, ul. Akademicka 7, 44-100 Gliwice (POLAND), beata.kucharczyk-brus@polsl.pl

[4] Politechnika Śląska, Wydział Architektury, ul. Akademicka 7, 44-100 Gliwice (POLAND), agata.wycislok@polsl.pl

aimed at introducing changes to the existing system, even involving the legal requirement to use refurbished materials in newly emerging investments. Examples of such implementation can be observed in Poland and around the world, both inside and outside buildings.

2. STATISTICAL DATA ANALYSIS

2.1. Main Office of Construction Supervision

Construction traffic - building permits

As the construction movement undoubtedly translates directly into the production of building materials, and then into the production of construction and demolition waste, which is associated with every, even the smallest construction or renovation work, it is necessary to analyze the data on this sector in more detail. To learn about the current trends in housing construction, first of all, data from the General Office of Construction Supervision (GUNB) were analyzed. The available information shows that in the years 2012-2021 there is a clear upward trend in the number of facilities for which a building permit has been issued. We observe the same trend in the case of data on the number of issued decisions, however, as one decision may cover more than one object, the analysis of the number of objects was used. The more objects are built, the more materials are used and the more waste is produced.

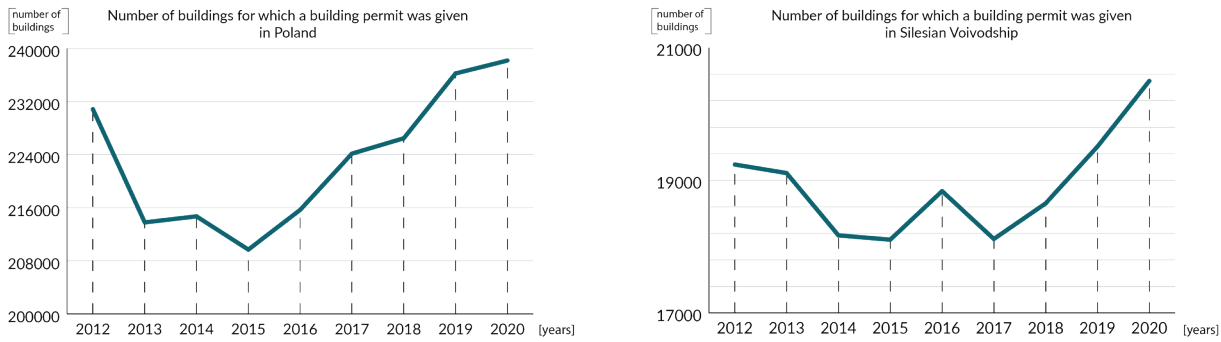


Fig. 1. Number of buildings for which a building permit was given in 2012-2020
Source: own study based on GUNB data [3]

After analyzing the percentage share of individual buildings in the total number of buildings for which a building permit has been given (Fig. 2.), it is clear that half of such decisions are issued for single-family houses. In the context of the reuse of building materials and waste, the focus should be placed in particular on this group of objects and on the raw materials most frequently used by them. A similar upward

trend occurs in the case of construction notifications (statistics have been kept since 2015), although, contrary to building permits, it mainly concerns free-standing single-storey buildings of transformer stations and container transformer stations, not single-family buildings.

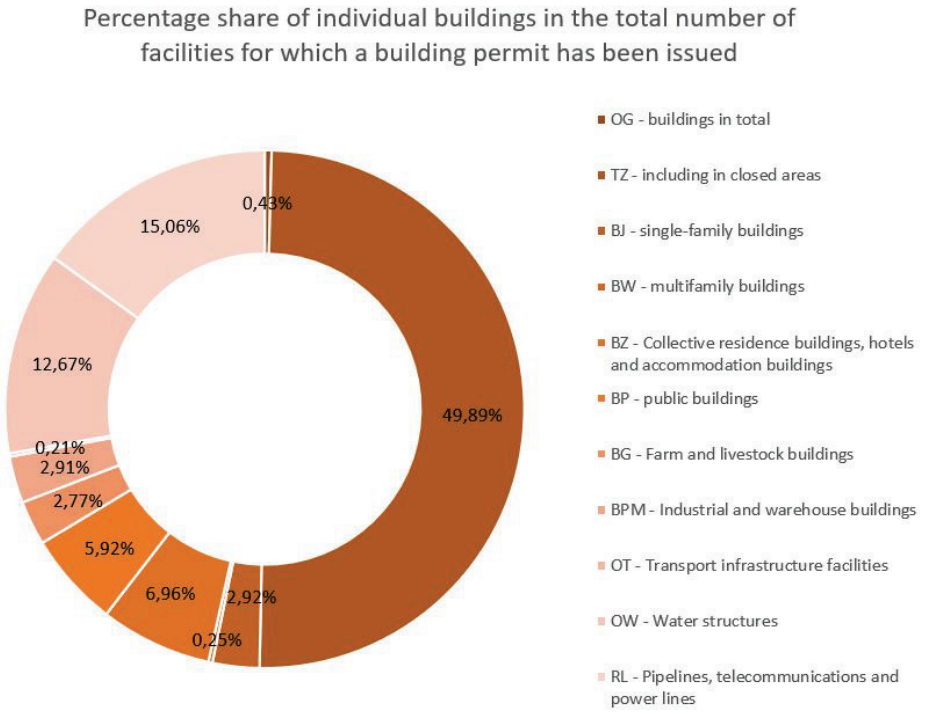


Fig. 2. Percentage share of individual buildings in the total number of facilities for which a building permit has been issued
Source: Own study based on GUNB data [3]

Construction traffic - demolitions

The next data under consideration concern demolition. As part of the construction traffic study, GUNB provides data on the demolitions performed. These data, however, take into account only the demolitions for which an official order was issued, and therefore were performed due to unauthorized construction, construction inconsistent with the conditions of the permit or improper maintenance of the facility. All demolitions that the investors have applied for themselves, as part of submitting the demolition permit application, have been included in the Register of Applications, Decisions and Notifications. As part of the analysis of these data [3], it was shown that in the period from 01.01.2016 to 19.09.2021 207,413 decisions were issued in the Silesian Voivodship, of which 8,110 were decisions on a permit for demolition. Within this pool, data was made into the relevant categories of construction objects that were demolished in the form of a percentage distribution. The presented diagram (Fig. 3) shows that over 70% of all demolitions were objects

belonging to categories I, II and III, i.e. single-family residential buildings, buildings for agriculture, such as production, farm, livestock and other small buildings such as holiday homes, farm buildings, garages up to two parking lots.

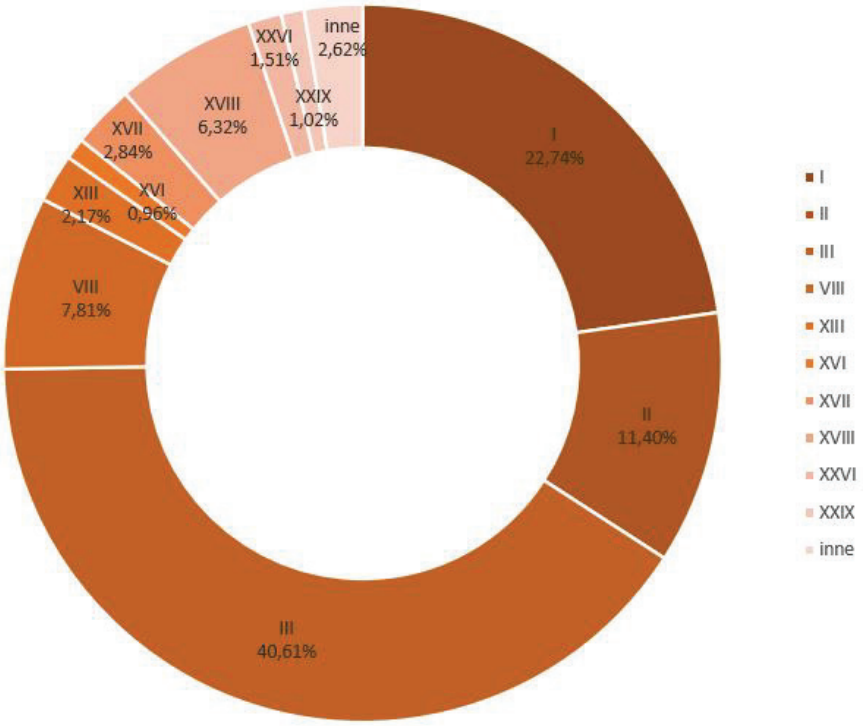


Fig. 3. Percentage distribution of building object categories in all demolition permits in 2016-2021
Source: Own study based on GUNB data [3]

We should also remember about demolitions not included in the register, i.e. those which, in accordance with Article 31 of the Construction Law Act [4], do not require a demolition permit, but contribute to the amount of demolition materials and waste produced. Therefore, it confirms that a significant part of the construction traffic is related to residential construction, single-family houses and related, small, non-residential buildings, in particular. Consequently, the conclusion may be drawn that the raw materials used in the above-mentioned areas of construction should be the focus of efforts towards the implementation of the circular economy and activities promoting and enabling the reuse of building materials.

2.2. BDO Register

The BDO register is *a register of entities introducing: products, products in packaging and managing waste, which is an integral part of the BDO system, i.e. a database on products and packaging and waste management* [5], which is designed to tighten the waste management system and increase the effectiveness of the fight

with informal economy and illegal landfills, and improve recycling rates. The obligation to enter into the BDO register and keep the waste register applies to entrepreneurs who produce waste and have a register of this waste. On the basis of data from the BDO, a voivodship report on waste management is prepared by the Marshal. Such a report consists of several parts. This research focused on three of them, which are waste generation, waste collection and waste management.

Each waste group has its own waste code, which is regulated by the ordinance of the Minister of Climate on the waste catalog [6]. To see the structure of construction and demolition waste, only the corresponding codes were selected, i.e., those from group 17. In this way, it was possible to obtain a data set presenting the amount of construction waste produced in the Silesian Voivodeship in recent years. The data contained in the reports do not provide information on the origin of the specific waste, therefore it is not possible to obtain data that would specify which amounts of materials are rejected during construction and which during demolition. Therefore, it was assumed that each construction site, regardless of the type of work performed, is a source of construction waste. On the basis of the previously analyzed construction traffic, it was possible to make a percentage distribution of construction projects for which construction permits had been issued.

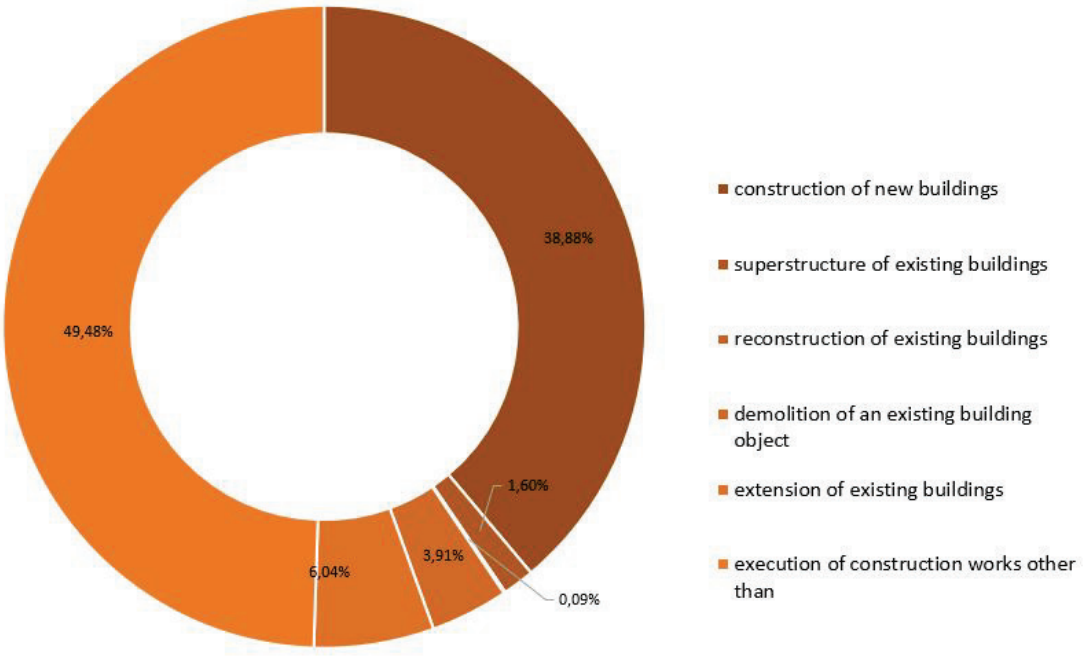


Fig. 4. Percentage distribution of construction projects for which a positive decision to conduct works has been issued

Source: Own study based on GUNB data [3]

Based on the available data, it was possible to develop the waste structure for the entire group 17, which includes all construction waste. In the next step, the structures of generated and collected construction waste were compared.

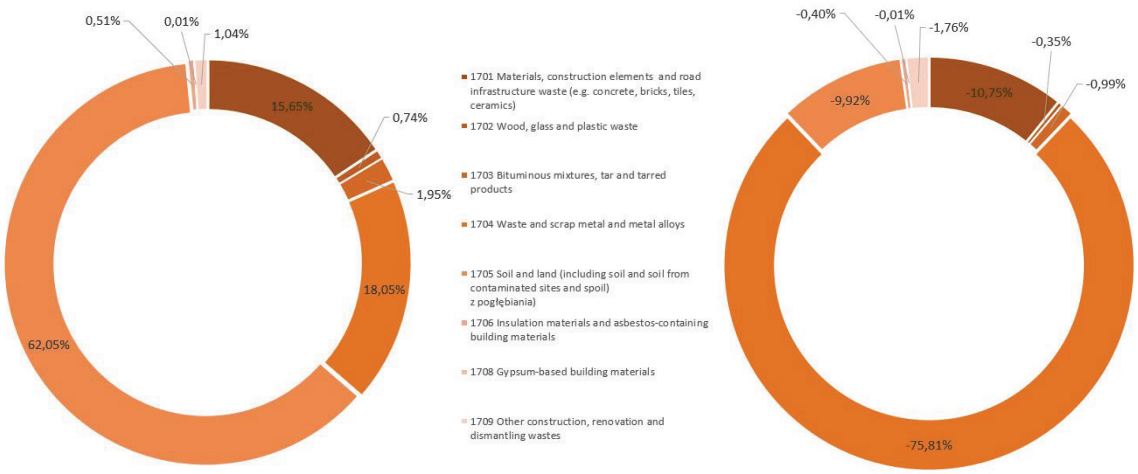


Fig. 5. Comparison of the structure of generated (left) and collected (right) construction waste
Source: Own study based on Silesian Voivodship data [7]

As the collected data present (Fig. 5) the amount of waste in mass units, it is not possible to select the largest group of construction waste, only the heaviest one. Therefore, in the next stages of the research, these data will be converted into more comparable units, which will enable the selection of the most numerous group of waste in the context of their reuse. However, it was possible to compare the structure of generated and collected waste. There is a clear difference especially in the case of waste from group 1705, i.e. containing soil and earth. This is because a significant proportion of this waste is recovered, mainly in the R5 process, which includes soil treatment and recovery. However, these are not activities related to architecture. It is also worth mentioning that in the case of voivodship reports, there is a certain amount of material that has not been taken into account in the statistics. This is because, pursuant to the Act on Waste [1], it is not necessary to report every amount of waste. The amounts of waste for which there is no obligation to keep records have been determined, and in addition, these amounts change from time to time with subsequent amendments to the aforementioned Act, therefore it may seem that less construction and demolition waste is produced, while this is not true.

2.3. Central Statistical Office (GUS)

Another source of data obtained for the analysis was the Central Statistical Office. On the basis of the obtained information, the changes in the price of 1 m^2 of usable floor space of a residential building over the last 22 years are presented in Figure 5. There is a clear upward trend, which is also related to the cost of building materials. Therefore, the search for new applications for construction waste and the reuse of materials seems to be profitable not only for environmental but also financial reasons.

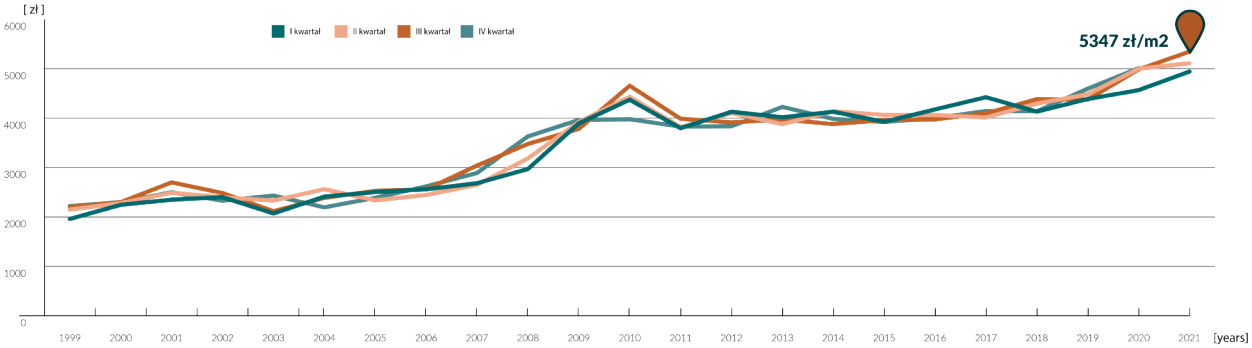


Fig. 6. Price for 1 m^2 of usable floor space of a residential building
Source: Own study based on GUS data [8]

Figure 7 presents the value and structure of construction and assembly production carried out by construction entities by main type of activity. There are three types of activity: building construction, engineering works and specialized construction works. As can be seen from the chart, these costs are constantly increasing. The largest part of them are specialized construction works, which include the costs of building and building finishings.

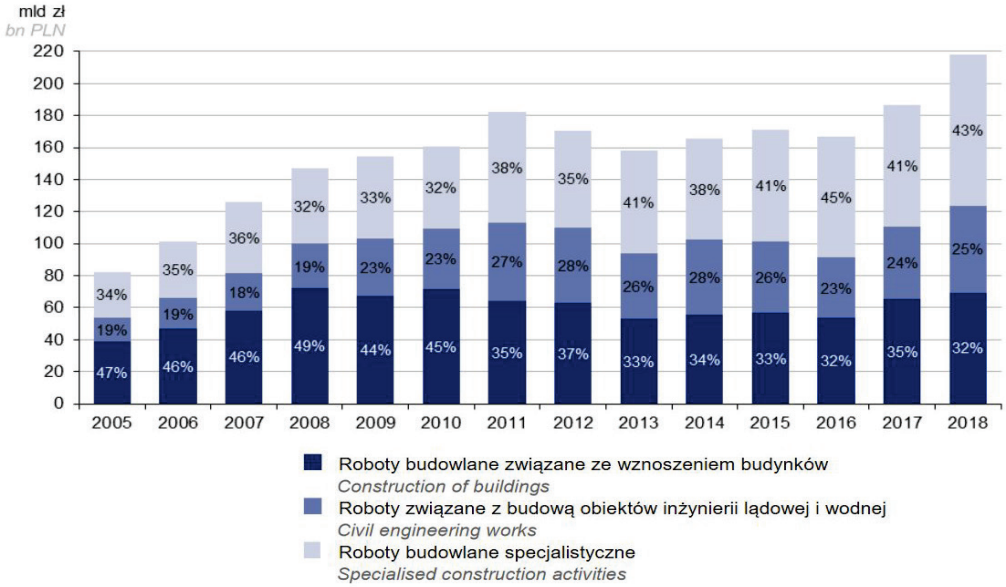


Fig. 7. Value and structure of construction and assembly production by construction entities by main type of activity
Source: GUS [9]

This is important due to the fact that almost half of the expenses of construction companies is spent on the purchase of materials, which is shown in the next statement prepared by the Central Statistical Office [9] based on data collected between 2012-2020. Considering Figure 8, we can assume that the cost of finishing materials plays an important role here. Therefore this is an area where solutions that use construction waste should be looked for.

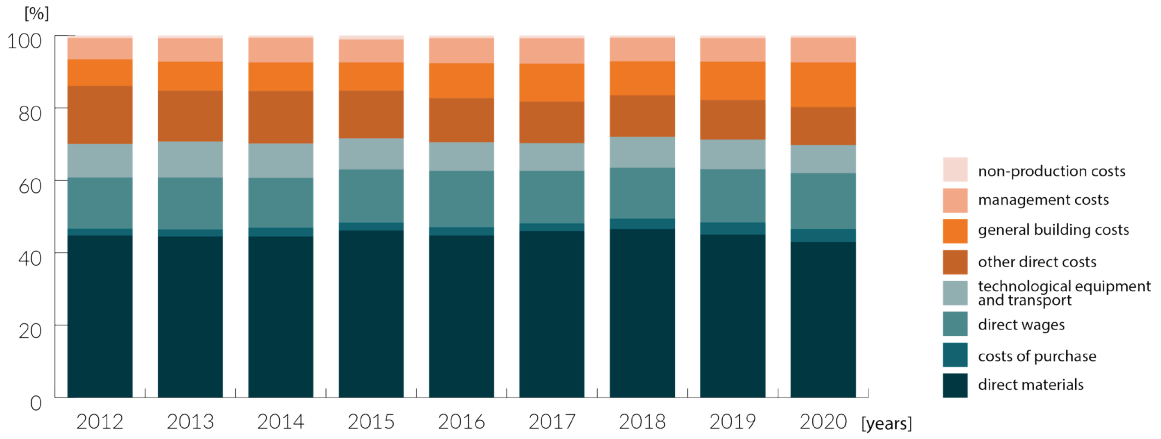


Fig. 8. The structure of the costs of construction and assembly production carried out in the territory of the country by construction companies in 2012-2020.
Source: Own study based on GUS data [10]

3. POSSIBILITIES OF THE REUSE OF BUILDING MATERIALS

The standard process of building demolition and site clearance has been very similar for the last several decades. Construction workers demolish with tools or machines that tear down the building at the construction site, and then the waste – loaded on a truck or container – is taken to a landfill. Usually, due to the lack of time and financial resources, and the tight schedule of construction works, the demolition waste remains mixed and in this form it is sent to the collection point. Deficiencies in appropriate segregation can also be observed in the selective waste collection points themselves, organized at the community or city level, where, pursuant to the applicable law [11], the so-called PSZOKs (Points of Selective Collection of Municipal Waste) were created. These points were created in connection with the obligation of municipalities and citizens to proper disposal of municipal waste. At the PSZOK, residents can dispose of, among others, construction waste, and the containers for them are described as follows [12]:

- **roofing felt and insulation materials** – the townsfolk throw: mineral wool, roofing felt, polystyrene, plastic films,
- **debris** – clean brick or concrete waste should be thrown there; unfortunately it is usually mixed with soil, plant fragments, and pieces of polystyrene that stuck to concrete or bricks,
- **mixed demolition materials** – all kinds of elements from demolition are placed there: plasterboards, bent steel, structural elements, windows, doors, paint and plaster containers, construction timber, as well as polystyrene fragments, remains of insulation wool etc., making it an uncleaned collection of various materials.

In this way, parts of the building that could be reused, such as doors, windows, timber (floors, parquet, paneling, roof truss elements, etc.), other roofing elements, finishing materials and others, are often not preserved but broken up, mixed with other waste making them not recyclable, and eventually deposited in a landfill. It should be noted that the construction waste includes not only large dimensions or mass materials, such as bricks, ceramic blocks, concrete, steel beams, insulation and wood, but also smaller ones, such as nuts and bolts, hinges, handles, electrical switchboards, etc. It is much easier to destroy and mix altogether than invest in the complicated and costly logistics of separating different materials, storing them and searching for a market to sell them or a place for reuse.

However, due to growing environmental awareness and social pressure to create more sustainable solutions, we are slowly moving towards a better process of

recycling and reuse of previously generated resources. Landfill fees have risen sharply in recent years, prompting contractors to look for alternatives to dumping construction waste. The differences in prices for the export of construction waste are presented in Table 1.

Table 1

Comparison of prices for the export of construction waste in 2017 and 2021

Type of waste	**Prices from 2017**		**Prices from 2021**	
	Bag BIG-BAG 1 m³	**Container 5 m3**	**Bag BIG-BAG 1 m³**	**Container 5 m³**
Clean rubble	140,- PLN	290,- PLN	380,- PLN	550,- PLN
Mixed waste	150,- PLN	340,- PLN	No data	2,130,- PLN
Roofing felt	No data	No data	600,- PLN	2,130,- PLN
Mixed waste without construction debris and soil	No data	No data	No data	1,260,- PLN
Insulating materials (mineral wool, polystyrene); wet wool: + 30% of the price	No data	No data	No data	1,070,- PLN

* The prices of Czerwony Hasiok's services, Gliwice; source: own study based on https://czerwony-hasiok.pl/

Many architects and contractors are therefore looking for ways to give a second life to building materials. There are more and more examples of architectural objects that use recycled materials in the interior, on the façades as well as in other parts of the building. They are sometimes used in a way for which they were previously intended - as windows or doors after renovation, giving the building its original, authentic aesthetic expression. They are sometimes used in a processed way – deconstructed, fragmented, used as decoration, an artistic composition or as a finishing material for the surface of walls or ceilings. And they are also used in a surprising way, completely different from the original one, as an element distinguishing an object from others, with a similar function, giving it an individual content and conveying a message about the ecological awareness of the designer and investor. Examples of the use of demolition materials for new investments are presented in Table 2.

Table 2

Examples of reuse of selected building materials

Material type	Secondary use	Comment
Construction timber		**Residential building in a row of terraced houses,** arch.: M. Brus; 2017, Zakopane To finish the slants of the roof slopes, cut structural beams from the dismantled old highlander hut were used. Part of the timber was used to make furniture for the interior. Photo: author
Construction timber		**Detached residential building,** arch.: M.Brus; 2009, Zabrze Structural beams of the old roof truss of the former Silesian tenement house were used on the facade of the new building, at the investor's request, as an imitation of the half-timbered structure of the external wall and as a structure of small architecture form. Photo: author
Ceramic brick		**Cubo House**, arch.: PHOOEY Architects; 2013, Melbourne, pow. 410 m^2 A sustainable building in which old elements of the wall structure were used and exposed, without hiding their original purpose, giving them a chance to adapt and re-exist. Photo: [13]
Floor and wall tiles: cement, porcelain stoneware, glazed		**Underpass,** Riomaggiore Elements of various materials (cement tiles, porcelain tiles, stone, timber, steel) formerly used as floors and facings in buildings were used to make a mosaic wall decorating an underground passage in the public space. Photo: author

Steel		**The recycled house,** Reykiavik House of Hrafn Gunnlaughsson, the director of the legendary movie: *When the Raven Flies*, built into the wharf, constructed from fragments of residential buildings and parts and elements of ship equipment, constituting a kind of utilitarian sculpture, the assemblage perfectly blended into the surrounding sea landscape. Photo: author
Doors		**The Circular Pavilion,** arch.: Encore Heureux Architects; 2015, Paryż, pow. 70 m^2 A single pavilion built for the COP 21 (United Nations Conference on Climate Change 2015) in Paris. The name describes the circular economy process where one's own waste becomes a resource for others. Photo: [14]
Windows		**Kamikatz Public House,** arch.: Hiroshi Nakamura & NAP; 2015, Tokushima Prefecture, Japan Design of a shop selling beer and other products by weight, including a brewery and a pub. As the creators write: *we collected the windows that used to illuminate the city and we wanted them to serve as a beacon of hope, to shine over the city struggling with a declining population*. Photo: [15]

4. CONCLUSION

As the data presented in the paper show, more buildings are being built each year. According to the Waste Management Plan for the Silesian Voivodeship for the years 2016-2022, the forecasted mass of generated waste from construction and renovation in 2016-2028 will increase [16]. Each building permit represents a new construction site that will generate construction waste, and the construction and demolition processes themselves are a potential source of materials. All new buildings can be potential material banks in the future, and the increase in construction activity in recent years contributes to the need to develop a waste reduction strategy and better management of building materials.

Good practices for the reuse of building materials should be applied not only by small investors, not only in times of crisis and shortage of materials, but as a common phenomenon in the construction industry. As shown by examples of architectural realizations applying the principle of circular economy, demolition materials are not only an economically available product, but also carry additional aesthetic and ideological content.

In order to deepen the knowledge about the possibilities of using demolition materials and their widespread implementation in the design and construction process, it is necessary to analyze the ways of demolition works, to indicate how to store elements, to develop criteria for assessing the quality of the obtained materials (including their strength and other technical parameters determining possibilities and the place of their reuse), to analyze and point potential sales markets (individual construction, developer investments, local government projects, etc.).

LITERATURE AND REFERENCES

1. Ustawa z dnia 14 grudnia 2012 r. *o odpadach*, Dz.U. 2013, poz. 21, ze zm.
2. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics (accessed: 15.09.2021).
3. http://wyszukiwarka.gunb.gov.pl/pobranie.html (accessed: 15.09.2021).
4. Ustawa z dnia 7 lipca 1994 r. *Prawo budowlane*. Dz.U. 1994 nr 89, poz. 414 ze zm.
5. https://www.biznes.gov.pl/pl/firma/obowiazki-przedsiebiorcy/chce-wypelniac-obowiazki-srodowiskowe/proc_170-wpis-do-rejestru-bdo-podmioty-wprowadzajace-produkty-produkty-w-opakowaniach-i-gospodarujace-odpadami (accessed: 15.09.2021).
6. Rozporządzenie Ministra Klimatu z dnia 2 stycznia 2020 r. *w sprawie katalogu odpadów*. Dz.U. 2020, poz. 10.
7. Raporty województwa dotyczące gospodarki odpadami, Urząd Marszałkowski Województwa Śląskiego, Katowice 2012-2018, https://bip.slaskie.pl/dzialalnosc_urzedu/srodowisko/raporty-wojewodztwa-dotyczace-gospodarki-odpadami.html (accessed: 2.03.2020). https://bip.slaskie.pl/dzialalnosc_urzedu/srodowisko/raporty-wojewodztwa-dotyczace-gospodarki-odpadami.html (accessed: 2.03.2020).
8. Cena 1 m2 powierzchni użytkowej budynku mieszkalnego oddanego do użytkowania, Główny Urząd Statystyczny, Warszawa 1998-2021, https://stat.gov.pl/obszary-tematyczne/przemysl-budownictwo-srodki-trwale/budownictwo/cena-1-m2-powierzchni-uzytkowej-budynku-mieszkalnego-oddanego-do-uzytkowania,8,1.html# (accessed: 02.03.2022).

9. Produkcja budowlano montażowa w 2018 r., Główny Urząd Statystyczny, Warszawa 2018.
10. Produkcja budowlano montażowa, Główny Urząd Statystyczny, Warszawa 2012-2020.
11. Rozporządzenie Ministra Środowiska z dnia 29 grudnia 2016 r. *w sprawie szczegółowego sposobu selektywnego zbierania wybranych frakcji odpadów*. Dz.U. 2017 r., poz. 19.
12. PSZOK Gliwice, Biuletyn Informacji Publicznej Urzędu Miejskiego w Gliwicach, wrzesień 2020, https://bip.gliwice.eu/punkty-selektywnej-zbiorki-odpadow-komunalnych (accessed: 2.03.2022).
13. https://www.metalocus.es/en/news/cubo-house-phooey-architects (accessed: 15.10.2021).
14. The Circular Pavilion / Encore Heureux Architects, ArchDaily 2015. https://www.archdaily.com/778972/the-circular-pavilion-encore-heureux-architects (accessed: 15.10.2021), ISSN 0719-8884.
15. Kamikatz Public House, Architizer, https://architizer.com/blog/projects/kamikatz-public-house/ (accessed: 15.10.2021).
16. *Plan gospodarki odpadami dla województwa śląskiego na lata 2016-2022*, Urząd Marszałkowski Województwa Śląskiego w Katowicach, Katowice 2017 r., ISBN 978-83-7328-900-0.

Ada KOŁODZIEJCZYK-KĘSOŃ[5]

THE PASSIVE BUILDING STANDARDS – ARCHITECTURAL COMPARISON

INTRODUCTION

In XXI century, we have to struggle with many crises. Beginning from COVID – 19 pandemic, economic issues, extreme weather changes, to environmental concerns. The future of our planet is threatened by devastating impact of air pollution. To fight this crisis the European Commission developed a plan to reduce the CO_2 emission [1]. Building sector emits 40% of total CO_2 and consumes one third of global, final energy. Extreme weather conditions led to the peak of the CO_2 emission in 2019, caused by increase of the annual demand for commercial heating and cooling [2], [3], [4], [5], [6], [7], [8]. To adapt to climate variations, it is essential to find building solution that would be energy – efficient, will consume less electricity and other power sources, and will not overheat which has negative effect on human health [9] and is observed even in temperate climate [10], [11], [12].

Architects should design buildings with low heat and cooling demand that will not overheat in the summer thanks to high-tech, but due to proper cubature and passive architectural design solutions. Buildings should be sustainable [13], [14] and fulfill all three pillars of sustainability (economic, social and environmental) [15]. Those elements define sustainable development [16]. All above will reduce CO_2 emission. The most suitable solutions are passive buildings, that do not need complicated systems but can be designed simple and by means proven over the years. This article will compare Passive House, be2226 and Earth House standard.

The Earth House standard also called Earth Shelters draws from the nature which facilitates achieving of perceptible benefits. As ecological architecture this trend includes green architecture design [17]. The Passive House concept bases on cheap, simple and energy efficient building. The new be 2226 standard bases on sustainable, energy efficient constructing method that eliminates conventional heating [18].

This article presents an architectural comparison of above standards, that use straightforward architectural procedures to design passive, energy efficient buildings that do not need active high-technology to manage inside comfortable climate. Those buildings are characterized by the low heating and cooling energy demand. The

[5] Silesian University of Technology (POLAND), Ada.Kolodziejczyk-Keson@polsl.pl

article will present discussion of advantages and disadvantages of selected buildings constructed in those standards. The aim is to compare, evaluate and describe passive design guidelines.

RESEARCH METHODS

Author used following methods and techniques [19]:

Comparative case studies - visual inspection, description, analysis of documents, clarification, interpretation, benchmarking, measurement, counting, observation

Literature review – criticism of the problem in correlation with what has been achieved in the relevant scientific field.

Due to the nature of the problem addressed, the article bases on direct – in situ and indirect research of critical analysis of documentation and literature of 53 items connected to the described problem. Direct research includes visiting object in situ with visual inspection, observation and own measurements. In the research the Author used comparative case studies method, that enables to draw conclusions relating to the selected features of the characterized building. The feature of case study method is to analyze the issue in a wider context presented also loosely related objects to compared standards also taking into consideration comfort of users.

Despite wide range of passive standards Author chose to focus on three of them – Passive House, be 2226 and Earth House as the simplest and passive in architectural point of view.

Author researched in situ twenty Passive House public utility buildings constructed between 2011 and 2020. Selected parameters were obtained from technical documentation and Author's own measurements and observations.

For 'be 2226' buildings and Earth Houses the Author used literature review and documentation analysis. The in situ researches were unavailable due to the COVID-19 restrictions.

The Author compared chosen parameters related to three passive standards, described and labelled them, then lists the most desirable and important elements for architect to be implied in passive design.

PASSIVE STANDARDS

People must fulfill their needs starting from the basic ones. Maslow's pyramid of needs has the most basic biological and physiological ones, like shelter, at its base. Higher in the pyramid are necessities of safety, social, esteem and self-actualization. When basic needs are met, human tries to fulfill more advanced ones [20]. From the

beginning of humankind people tried to shelter themselves, either by finding natural formation [21] like cave or by building earth shelters. With time, people started to construct more complex objects to fulfill their psychological needs. Design should implement psychological aspects of built environment [22], [23], [24], [25], but first it has to fulfill physiology, comfort and behavior needs [26]. Now we are in the highest point of pyramid, trying to fulfill self-actualization with climate care and environmental future thinking.

Architecture is a form of evolution, sometimes it is necessary to learn from old, good practice and return to it with a better understanding and the ability to adapt it to modern needs. The building is determined by three equal parameters: use, construction / design, and form. All three elements should harmonize with landscape and build environment. The roof and the body of the building should be shaped as a whole. Frederick Kiesler in his scholarly work "Inside the endless-house", notes that no object in nature or art exists outside of its environment.

Earth House standard

The Earth House system is under-earth and earth-covered building stemming from ecological architecture trend that contains green architecture design. The basic principles of environmentally friendly architecture and Earth House standard are: smaller buildings, use of recycled and energy-efficient materials, low maintenance costs with fossil fuels reduction for heating and cooling, design appropriate to the climate, reuse of existing buildings, preserving natural environment, orientation in relation to the sun [17].

Emilio Ambasz design ecological architecture integrated into the surrounding landscape and vegetation. He uses a broad ecological, philosophical, poetic and aesthetic reference in his work. To create distinct spatial systems, he uses the topography of the terrain and vegetation. Geometry, reduced to minimalist forms, is an element of his architectural language, which functions as a code to refer to the landscape and emphasize its presence. Earth-covered buildings (Earth Houses) such as Schlumberger Laboratories [Fig. 1] provide better thermal insulation in all seasons [17].

Fig. 1. Schlumberger Research Laboratories, Emilio Ambasz, Austin, Texas, USA, project 1983 photography from book Zielona architektura James Wines, Taschen/TMC Art, 2008, page 69

Between 1984 and 1989 Hundertwasser was working on housing estate called In The Meadow Hills [Fig. 2]. It was study project with architect Peter Pelikan. They wanted to create natural, harmonious, totally green houses, that can be walked upon [27]. In Hundertwasser's manifesto, he pointed out, that houses will be energy-saving and will keep interior comfort for inhabitants - latently cool in summer and warm in winter. The neighbours would benefit from high quality life not only reserved for residents [28]. One of the reasons why the project was not realized was opposition of a citizens' action group. They were afraid of disturbances in residential area caused by hordes of tourists [29].

Fig. 2. In the Meadow Hills housing project, Hundertwasser, photograph taken from architecture model 1:50: Atelier Alfred Schmid, 1989 exhibited in Hundertwasser Museum (photo A. Kołodziejczyk-Kęsoń)

In contrast to the residents' opposition to the Hunertwasser's In The Meadow Hills project, Gustav Peichl designed an earthen complex for the EFA Radio Satellite Station in Aflenz, Austria in response to the protest of the residents of Grassnitz. They objected to the detrimental impact on protected mountain areas. The buildings for the transmitting station, housing for the staff, offices and recreational facilities are completely underground, integrated into the surroundings with earth-covered roofs and fencing in the form of earth ramparts [17] [Fig. 3].

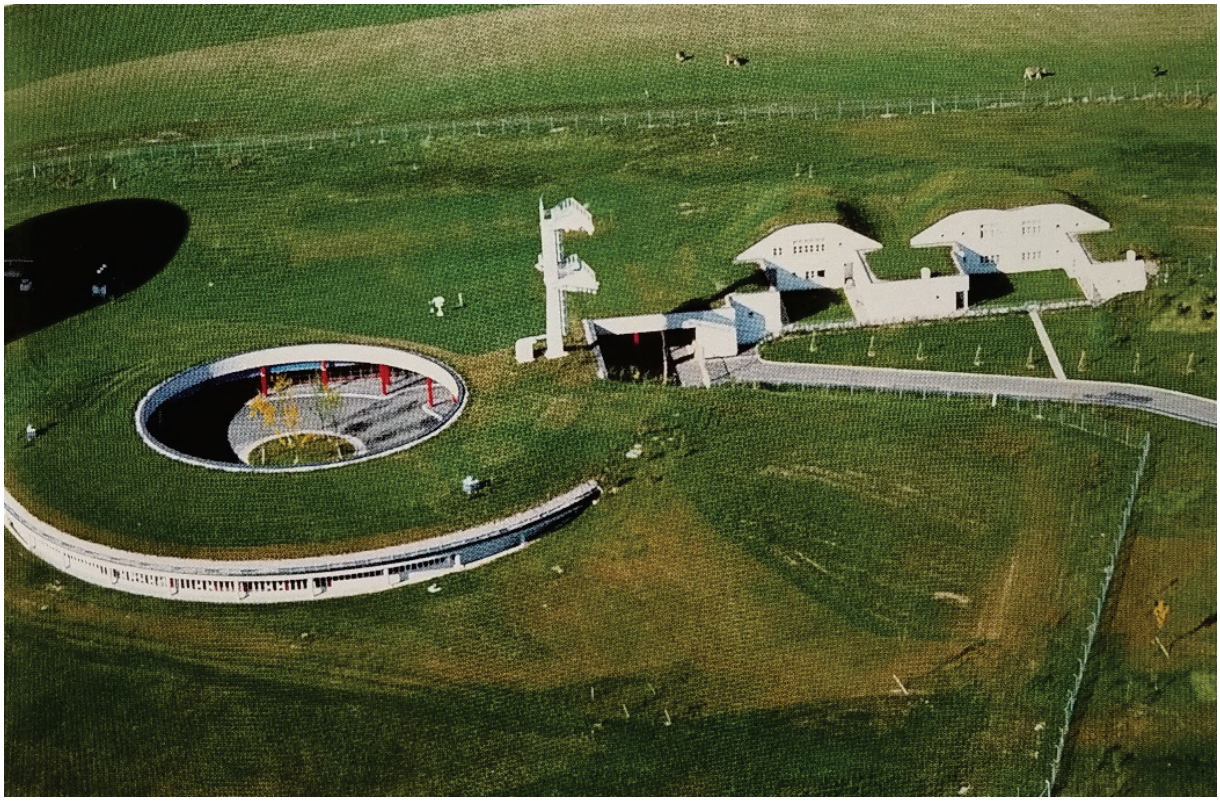


Fig. 3. EFA Radio Satellite Station in Aflenz, Gustav Peichl, Aflenz, Austria, 1976-1979 photography from book Zielona architektura James Wines, Taschen/TMC Art, 2008, page 69

The Earth House Estate Lättenstrasse in Switzerland is a complex of dwellings surround by U-shaped hill around a pond designed by Versch Architektur [Fig. 4]. Buildings reside within their environment and continue natural land contours. The earth and clumps of vegetation plants plays an insulation role, that protects buildings from rain, low and high temperatures, wind and natural abrasion. In the building, the living area is located in the south and sleeping area to the north [30]. Those buildings are extremely environmentally friendly and energy efficient and characterize with pleasant, balanced indoor climate with healthy humidity of 50 percent due to inner clay walls [31].

Fig. 4. The Earth House Estate Lättenstrasse in Switzerland by vetsch architektur (http://www.erdhaus.ch/erdhaumluser--earth-houses.html)

Passive House standard

Energy-efficient Passive House standard characterizes with extremely low heat demand. Venting air should be the only source of heating. The indoor climate comfort should be obtained without air conditioning in the summer and in the winter by means of energy gains from sun, heat generated by users and electrical equipment and heat recovered from ventilated air.

For certification, the Passive House has to meet the following criteria [32], [33], [34], [35], [36]:

- heating demand EUco+w ≤ 15kWh/m2a or thermal load ≤ 10W/m2;
- cooling demand ≤ 15kWh/m2a;
- primary energy demand for heating and cooling ≤ 60 kWh/m2a (compared to ≤120 kWh/m2a of previous years);
- airtightness ≤ 0.6h-1;
- excessive temperature frequency (above 25oC) ≤ 10% hours per year.

The Passive House standard is very popular in housing design, but it is also implemented in public utility buildings. Author researched in situ 20 Passive House Polish public utility buildings, among them six sports halls [Fig. 5], three kindergartens, three office buildings, three health care centers and one of each: primary school, swimming pool, hotel, cultural centre and industrial building.

Fig. 5. Passive hall of the University of Agriculture in Kraków by Architektura Pasywna Pyszczek i Stelmach (photograph A. Kołodziejczyk-Kęsoń)

be 2226 standard

The be 2226 standard assumes, that building will not need any conventional heating or cooling. Depending on the season, the wall surface temperature is between 22 and 26^{o}C. The CO_2 sensors controls indoor temperature by opening and closing vertical vents placed by the windows [37]. The storage capacity of the walls pays significant role in heat transfer [38]. The sources of heat in building are: solar, human body, electrical devices and artificial lightning heat. Author examined literature and documentation of the be 2226 prototype office building, designed by baumschlager eberle architekten, and located in Lustenau in Austria [Fig. 6]. The in situ research was not possible because of COVID-19 pandemic restrictions.

Fig. 6. The be 2226 prototype office building, designed by baumschlager eberle architekten, Lustenau in Austria (https://www.baumschlager-eberle.com/en/work/projects/projekte-details/2226-lustenau/)

PASSIVE STANDARDS COMPARISON

Table 1

Comparison of passive standards

Examined parameter	Earth House	Passive House	be 2226
1	2	3	4
Daylight delivery	Daylight is delivered only from one side of building, that is not covered by earth and through skylights. Some buildings have inside dark areas.	Daylight is delivered mainly through South, West and East glazing. From the North the daylight is limited to necessary glazing.	Daylight is equally delivered inside by evenly distributed windows.
Perforation of façades	Only one façade and roof have windows or skylights	In 55 percent of examined buildings most perforations are on the southern façade and deviation from the north is between 1 to 48°.	All façades are perforated equally and 16 percent of each façade surface is glazing.

Ventilation	In buildings without mechanical ventilation there is a problem with efficiency of natural ventilation that can lead to humidity and mould risk.	The mechanical ventilation should keep indoor comfort on highest level and should be the heat source. When poorly maintained and set, can lead to health hazard and sick-building syndrome.	The ventilation is carried out by means of vertical vents placed near all windows. The vents are controlled by the CO_2 sensors. Can lead to droughts.
Number of storeys	One to three storey buildings. Depends on landscape.	Any number of storeys is allowed. Examined buildings didn't exceeded four.	Static requirements allow maximum six floors.
Location and depending on landscape	Yes The building must fit in with the landscape.	Yes/No The building is related to site conditions, but can be easily modified.	No The building can be located everywhere.
Roof	Green roofs - construction covered with thermoinsulation and earth with vegetation layer of plants.	In investigated buildings mainly conventional flat or pitched roof. But can be of any kind.	Over the conventionally thermoinsulated roof there is a layer of round grain gravel.
Shading	No external shading was implemented, users could install shadings by themselves.	Yes Due to overheat in summer it is necessary to use external shadings in variety of forms.	No shading was installed in the building.
Inside temperature	Stable due to insulation and earth layer.	Constant 20°C	Between 22 and 26°C
Humidity	Can be too high	Can be too low because of mechanical ventilation.	Not below 40% due to the wall ability to absorb and storage water vapor [39].
Noise	Low	From outside very low – no necessity of opening windows, from inside mechanical ventilation sounds.	From inside very low, from outside can be problematic in noisy polluted areas when vents are open.

Possibility of lifespan extension when function is not needed	No	Yes/No	Yes
Elimination of conventional heating and cooling	No	Yes	Yes
Sustainable	Yes	Yes	Yes
Adaptive comfort	Yes/No	Yes	Yes
Adapts to users' daily schedule	No	Yes	Yes
Economy aspect - environmental, construction and operational savings	Yes	Yes	Yes
Adaptable architecture / flexibility	No Low possibility of adaptation and change of function. Even extension of the building can be problematic	Yes/No Possibility of adaptation depends on project and open plan of building. Examined examples had rather closed plan related to function.	Yes It is easy to adapt building to another function over time, the plan is open
Bioclimatic	Yes	Yes	Yes
Rhythmic building	No	No	Yes
Environmentally friendly	Yes	Yes	Yes
Overheating	Yes	Yes	No
Airtightness	No	Yes	No
Elimination of thermal bridges	Not necessary	Yes	No

Source: Authors own elaboration

THE GUIDANCES

Basically, all investigated passive standards are eco-friendly with low energy demand, sustainable, bioclimatic systems. In particular each has its disadvantages,

that the other solves. By choosing all positive features and mixing standard parameters the nearly ideal system can be created.

The Author's proposal is to design buildings, that have daylight delivered equally throughout the building, so that the open plan can be introduced, that can lead to extended lifespan of a building. It does not mean that all façades should be glazing, e.g. in be 2226 standard only 16 percent of wall glazing is enough. To minimalize overheating it is also important to use thermal storage construction elements. The ceramic building materials can maintain favorable humidity level. Author thinks it is beneficial and most efficient to have an airtight building with mechanical ventilation, but with CO_2 sensors and opening vents control system. When needed CO_2 sensors would open windows and shut ventilation off. When user would like to manually open vent, the signal to shut down ventilation should also be released. This solution could eliminate problem of users' discomfort in Passive House buildings caused by ventilation program set for dedicated room and the number of users. The possibility of mixed construction could extend number of floors. It is necessary to respect context and landscape of a location, but architect can also create plot development with open water, trees and green elements, that can also reduce summer overheating and create favorable plot micro climate. Author strongly advises the use of green roofs which not only reduce overheating but also thermoisolate the building. The new system should be sustainable, flexible, rhythmic, environmentally friendly, adaptive and characterize by environmental, construction and operational savings.

DISCUSSION

The purpose of architecture and construction is to provide users with stable temperature of indoor climate. The standardization committee of each country sets optimal conditions for users, ex. temperature between 18-25^{o}C and humidity between 40-50%. All examined standards tried to fulfill those requirements. But during usage some problems occurred.

The building plot price is higher every year and the number of available building plots is getting smaller, especially in cities, which is why multi - storey buildings are designed. The restriction of six floors for be 2226 standard can be a disadvantage. Building up hundreds of hectares of land every year leads to ecological problems, so each building plot must be used to the maximum [40]. Every building means a loss of vegetation land and leads to a local climate change. Olgyay [41] states, that

important aspect of adaptable architecture is topography of a place and should be taken into account during design process. That is why Earth House standard gives nearly all vegetation area back to the nature. Research results of Lester L. Boyer indicate that structural safety, thermal stability and acoustical environment satisfies users of Earth Houses. Some of them have concerns of site design, daylight, thermal radiation control, and energy performance [42]. There is also thread of radon accumulation risk in underground buildings [31]. In cities it is impossible to create Earth House, but slight adaptation can be made in this regard.

Friedensreich Hundertwasser introduced, as a mandatory necessity in construction in the city, idea of green and tree-covered roofs and terraces [43]. These assumptions can be seen in Hundertwasserhouse in Vienna, Austria [Fig.7]. The entire volume of land where this building is settled was given back to nature. The idea of “building freedom” and “window right” may be questionable, especially in the light of maintaining the principles of spatial order and compliance with building regulations. Nevertheless, the idea of implementation green and trees in the very center of the city is a very good postulate. The overheating of all downtowns dominated by concrete with no shade and humidity delivered by living green organisms is a major problem for inhabitants. In Graz in Austria in UNIQA building a continuation of good green thinking is visible in green roof and terraces. [Fig. 8]

The Passive House buildings tend to overheat during summer [44]. Research results shows problems with overheating in summers and poor air quality from mechanical ventilation [45], [46], [47] that can lead to the sick building syndrome [48], [49], [50], [51], [52], [53] Shadings are partial solution, the good design of plot with elements like deciduous trees and introducing open water in spot can reduce overheat.

Fig. 7. Hundertwasserhouse in Vienna, Austria (photo A. Kołodziejczyk-Kęsoń)

Fig. 8. UNIQA building in Graz, Austria (photo A. Kołodziejczyk-Kęsoń)

CONCLUSION

The expenditure for a good design can save money (during operation and lifecycle), environment and our future. Low heat and cooling demand lead to CO_2 reduction.

All buildings should be sustainable and low energy designed by means of chosen, passive, favourable components of presented in this article systems. All systems have disadvantages. The Earth House system is the most problematic and not suitable for all conditions. Passive House and be 2226 appear to be more flexible and suitable for a wider range of uses and local environments. However, the height limitations of be 2226 buildings may be restrictive. It would be beneficial to take the best parameters and elements from each discussed passive system and implement them to the design.

Regardless of a function of a building it should be built, as a passive, open plan object to extend its lifespan. The daylight should be delivered equally to the building from all cardinal directions to enable open plan changes. Architectural creation has great impact on passive solutions. The shape, orientation, glazing, shading, plot organization, green elements influence building thermal efficiency and can improve indoor quality and comfort.

BIBLIOGRAPHY

1 Communication from the Commission to the European Parliament, the Council, "The European Economic and Social Committee and the Committee of Regions, Stepping up Europe's 2030 climate ambition Investing in a climate-neutral future for the benefit of our people," Brussels, on 17.9.2020, COM(2020) 562 final.

2 https://www.iea.org/topics/buildings, access date 28.05.2021.

3 Ford B.: Passive downdraught evaporative cooling: Principles and practice. Architectural Research Quarterly, vol. 5(3), 2001, pp. 271-280.

4 Flynn E.: (Experimenting with) Living Architecture: A practice perspective. Architectural Research Quarterly, vol. 20(1), 2016, pp. 20-28.

5 Schiano-Phan R.: Environmental retrofit: Building integrated passive cooling in housing. Architectural Research Quarterly, vol. 14(2), 2010, pp. 139-151.

6 Pylsy P., Lylykangas K., Kurnitski J.: Buildings' energy efficiency measures effect on CO_2 emissions in combined heating, cooling and electricity production, Renewable and Sustainable Energy Reviews, vol. 134, 2020, pp. 110-299.

7 Lin Y.-H., Lin M.-D., Tsai K.-T., Deng M.-J., Ishii H.: Multi-objective optimization design of green building envelopes and air conditioning systems for energy conservation and CO2 emission reduction, Sustainable Cities and Society, vol. 64, 2021, pp. 102555.

8 Piccardo C., Dodoo A., Gustavsson L.: Retrofitting a building to passive house level: A life cycle carbon balance, Energy and Buildings, vol. 223, 2020, pp. 110-135.
9 Hajat S., Vardoulakis S., Heaviside C., Eggen B.: Climate change effects on human health: projections of temperature-related mortality for the UK during the 2020s, 2050s and 2080s, J. Epidemiol. Community Health, vol. 68 (7), 2014, pp. 641-648.
10 Beizaee A., Lomas K.J., Firth S.K.: National survey of summertime temperatures and overheating risk in English homes, Build. Environ., vol. 65, 2013, pp. 1-17
11 Morgan C., Foster J.A., Poston A., Sharpe T.R.: Overheating in Scotland: contributing factors in occupied homes, Build. Res. Inf., vol. (1–2), 2017, pp. 143-156.
12 Lomas K.J., Porritt S.M.: Overheating in buildings: lessons from research, Build. Res. Inf. vol. 45 (1-2), 2017, pp. 1-18.
13 Hrivnak J.: Is relative sustainability relevant? Architectural Research Quarterly, vol. 11(2), 2007, pp. 167-176.
14 Voelcker A.: Handbook of Sustainable Building by David Anink, Chiel Boonstra and John Mak James and James, London, 1996176 pp. ISBN 1873936 389. (pb). Architectural Research Quarterly, vol. 3(3), 1999, pp. 286-286.
15 Purvis B., Mao Y., Robinson D.: Three pillars of sustainability: in search of conceptual origins, Sustainability Science. vol. 14 (3), 2019, pp. 681-695.
16 Ghisellini P., Cialani C., Ulgiati S.: A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems, Journal of Cleaner Production. Elsevier Ltd, vol. 114, 2016, pp. 11-32.
17 Wines J., red. Jodid P. Zielona architektura, Taschen/TMC Art, 2008 Köln.
18 Junghans L.: The Energy Concept in be 2226 The Temperature of Architecture Portrait of an Energy-Optimized House Edited by Dietmar Eberle and Florian Archer Basel, 45-54.
19 Niezabitowska E.D.: Metody i techniki badawcze w architekturze (Research methods and techniques in architecture). Wydawnictwo Politechniki Śląskiej, Gliwice 2014.
20 Dholakia-Lehenbauer K., Elliott E., Cordell B.: Economic rhythms, Maslow Windows and the new space frontier, Space Policy, vol. 28, Issue 4, 2012, pp. 291-298.
21 Ching F.D.K.: Architecture form, space, & order, A VNR Book John & sons, INC, Canada 1996.
22 Alders N.: Adaptive Thermal Comfort opportunities for dwellings: providing thermal comfort only when and where needed in Dwellings in The Netherlands, A+BE Architecture and the Built Environment, vol. 13, 2016.
23 Taleghani M., et al.: A review into thermal comfort in buildings, Renew. Sustain. Energy Rev., vol. 26, 2013, pp. 201-215.
24 Gruber P.: Biomimetics in Architecture: Architecture of Life and Buildings, Springer Wien, New York 2011.

25 van Ellen L.A.: Hybrid habitat for Mars: creating comfort with light, [in:] Proceedings of the International Astronautical Congress, IAC, 2019-Octob (June), 2019.
26 Harvey J., Heidrich O., Cairns K.: Psychological factors to motivate sustainable behaviours, Proc. Inst. Civ. Eng.: Urban Design and Planning, vol. 167 (4), 2014 pp. 165-174.
27 https://hundertwasser.com/en/ecology/arch75_das_huegelwiesenland_1094, access date 13.10.2021.
28 Hundertwasser's manifesto "In the Meadow Hills", 1989, Hundertwasser 1928-2000, Catalogue Raisonné, vol. 2, Taschen, Cologne, 2002, p. 1264.
29 Hundertwasser Architecture, Cologne, 1997, p. 236.
30 https://architizer.com/projects/earth-house-estate-laettenstrasse/ access date 29.10.2021
31 https://blog.allplan.com/en/earth-houses, access date 29.10.2021.
32 Feist W.: Passivhaus Projektierungs Paket 2002, Anforderungen an qualitaetsgepruefte, Passivhaeuser Passivhaus Institut, Darmstadt, Germany, 2002.
33 Feist W., Schnieders J., Dorer V., Haas A., Re-inventing air heating: convenient and comfortable within the frame of the passive house concept. Energy Build, vol. 37, 2005, pp. 1186-1203.
34 Feist W., Pfluger R., Kaufmann B., Schniders J., Kah O.: Passivehaus-Projektierungspaket Anforderungen an qualitaetsgepruefte Passivhaeuser, Passivhaus Institut, Darmstadt 2007.
35 Schnieders J., Hermelink A.: CEPHEUS results: measurements and occupants' satisfaction provide evidence for Passive House being an option for sustainable building Energy Policy, vol. 34, 2006, pp. 151-171.
36 Pitts A.: Passive House and Low Energy Buildings: Barriers and Opportunities for Future Development within UK Practice, Sustainability, vol. 9(2), 2017, pp. 272.
37 Hui P.S., Wong L.T., and Mui P.S.: Using carbon dioxide concentration to assess indoor air quality in offices, Indoor Built Environment, vol. 17, 2008, pp. 213-219.
38 Keller B., Magyari E.: A universally valid strategy for low energy houses, Renewable Energy, vol. 15, 1998, pp. 401-406.
39 Hugentobler W.: Health Aspects in be 2226 The Temperature of Architecture Portrait of an Energy-Optimized House Edited by Dietmar Eberle and Florian Archer Basel, pp. 143-153.
40 Wöhl V.: Der überforderte Alleskönner, Süddeutsche Zeitung Nr. 86/2002, München Instytut für Klima, Umwelt und Energie, Wuppertal.
41 Olgyay V.: Design with Climate: Bioclimatic Approach to Architectural Regionalism, Princeton University Press, Princeton 1963.
42 Boyer L.L.: Earth shelter trends in the south central plains, Editor(s): Lance Holthusen T.: The Potential of Earth-Sheltered and Underground Space, Pergamon, 1981, pp. 135-148.

43 Wiesauer C., 100XHundertwasser Artist – Visonary – Non-Conformist, Metroverlag 2016.
44 Kisilewicz T., Dudzińska A.: Summer overheating of a passive sports hall building. Archives of Civil and Mechanical Engineering, vol. 15, Issue 4, 2015, pp. 1193-1201.
45 V. Goncalves, Y. Ogunjimi, Y. Heo, “Scrutinizing modeling and analysis methods for evaluating overheating risks in passive houses”, Energy and Buildings, Volume 234, 2021, 110701, ISSN 0378-7788, https://doi.org/10.1016/j.enbuild.2020.110701.
46 G. Gourlis, I. Kovacic, “Passive measures for preventing summer overheating in industrial buildings under consideration of varying manufacturing process loads”, Energy, vol. 137, 2017, pp. 1175-1185, ISSN 0360-5442, https://doi.org/10.1016/j.energy.2017.05.134.
47 A. Sepúlveda, F. De Luca, M. Thalfeldt, J. Kurnitski, “Analyzing the fulfillment of daylight and overheating requirements in residential and office buildings in Estonia”, Building and Environment, Volume 180, 2020, 107036, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2020.107036.
48 L. Ah-Young, Y. Miryoung, K. Eun-Hye, K. Hyun-Ah, L. Myoung Ju, C. Hae-Kwan, “Effects of mechanical ventilation on indoor air quality and occupant health status in energy-efficient homes: A longitudinal field study”, Science of The Total Environment, Volume 785, 2021, https://doi.org/10.1016/j.scitotenv.2021.147324.
49 T. Ben-David, M. S. Waring, “Impact of natural versus mechanical ventilation on simulated indoor air quality and energy consumption in offices in fourteen U.S. cities”, Building and Environment, vol. 104, 2016, pp. 320-336, https://doi.org/10.1016/j.buildenv.2016.05.007.
50 N. Baker, (1996). The irritable occupant: Recent developments in thermal comfort theory. Architectural Research Quarterly, 2(2), pp. 84-90. doi:10.1017/S1359135500001287
51 J. Heyman, (1999). Developments in Structural Form by Rowland Mainstone 2nd editionArchitectural Press, Oxford, 1998384, pp. 310 mono, 50 line illus. ISBN 0750628936 (hb). Architectural Research Quarterly, 3(3), 285-286. doi:10.1017/S1359135500002116
52 C. Ramirez-Figueroa, R. Beckett, (2020). Living with buildings, living with microbes: Probiosis and architecture. Architectural Research Quarterly, 24(2), 155-168. doi:10.1017/S1359135520000202
53 J. Cook, (1997). The Skyscraper Bioclimatically Considered By Ken Yeang, Academy Editions, 1996. 269 pp., numerous illus. ISBN 1 85490 431 0 Price £29.95 PB. Architectural Research Quarterly, 2(3), 92-94. doi:10.1017/S1359135500001470

Aleksandra ŚLIWA[6]

COMPILATION DWELLING SPACE IN POST-PANDEMIC SMART CITY. THE POTENTIAL OF ADAPTATION OF APARTMENTS IN MULTIFAMILY BUILDINGS IN KATOWICE

THE IMPACT OF A GLOBAL PANDEMIC ON THE ISSUE OF HABITATION

In the urban environment, there are a variety of forms of habitation forming a complex urban collage of existence. The phenomenon of habitation is constantly evolving, changing the activities that define its state [1] and the cultural patterns that shape it [2]. The global pandemic is a peculiar anomaly that has affected the natural course of habitation transformations forcing a rapid change - the relocation into homes of functions previously performed in public buildings and spaces. Dwellings have become more intensively and diversely used by a larger number of users than before. Technology makes remote working and learning possible, but they still require a specific physical space that provides the right conditions for the people who perform them. Forced indoor living has also resulted in a lack of contact with nature. The prospect of outdoor living spaces has become an important incentive to settle in estates with access to balconies, terraces, and gardens. The phenomenon of the pandemic has exposed the shortages of housing, and has also revised the mechanism of residential outsourcing, which consists in carrying out housing-related activities outside the home, forced by the deficit of space. The post-pandemic home is meant to meet the needs of each inhabitant without compromising solutions that, under conditions of crisis, no longer fulfill their role.

The answer to the challenges posed to residential space is a compilation house defined by Grzegorz Nawrot, which operates simultaneously in the structure of the structure of the city and in the information cloud [1]. The post-pandemic Smart City will consist of smart dwellings, not specifically equipped with advanced technologies, but combining cultural, natural, and virtual elements.

According to the concept of sustainable development, cities evolve and adapt to new conditions. The aim of the research is to verify the possibility of adaptation of existing residential buildings to the requirements of compilation housing.

[6] Poland, Silesian University of Technology, Faculty of Architecture, Department of Residential and Public Architectural Design, aleksandra.sliwa@polsl.pl, nr ORCID 0000-0002-0964-5222

For the purposes of the research, I analyzed cases of apartments located in characteristic buildings of Katowice: in the “drapacz chmur" building at 15 Żwirki i Wigury Street, in the multi-family residential building “Superunit” [Superjednostka] in Korfantego Street in the center of Katowice and in the buildings commonly referred to as *“corn”* [Kukurydze] in Osiedle Tysiąclecia Housing Estate [Osiedle Tysiąclecia]. The research method is to analyze the structure of dwellings in the context of the functioning of zones correspondent to natural and virtual elements. Selected examples represent three alternative architectural layouts: dense, linear and concentric, the comparative analysis aims to indicate whether there are differences in the formation of housing layouts in the context of the organization of cultural, natural and virtual elements. Studied cases are examples of functioning buildings with defined spatial structure. The research does not include changes in the layout of partitions and interiors but verifies the possibility of adapting existing structures to introduce zones for nature and cyberspace.

COMPILATION DWELLING IN POST-PANDEMIC SMART CITY

The concept of smart city is a medium for improving the quality of life of its inhabitants according to the idea of sustainable development. In its 30 years of existence, the smart city concept has evolved from the original idea of using technology to improve the efficiency of urban structures, through remote control strategies, to an orientation towards optimal use of human potential [3] [4]. In this context, the Smart City is understood as an organism characterized by variability and complexity. Variability transfers the emphasis from temporary states to processes, thus enabling adaptation to crisis conditions [5] [6]. Complexity corresponds to the compilation form of multidimensionally constructed spatial systems as physical objects containing cultural, natural, and virtual elements, existing simultaneously in space and in consciousness [1]. Residential development as a transformed environment is an emanation of the cultural state of habitation as a course of action - the effect of human activity reflecting the state of civilization. Natural and virtual elements complement the basic cultural fabric of the compilation house.

Architectural interventions that are indeed transformations of the natural environment pursue, ultimately, the goal of harnessing and limiting it [7]. The natural elements present in cities can thus be interpreted in two manners: as preserved pristine elements or as artificial compositions from natural elements. In the urban context, the built and natural worlds remain in a human-dominated relationship, where human contact with nature is conditioned by a series of opposing interests. The pandemic crisis and its associated constraints have exposed the deficit of contact with nature within multi-family housing. The presence of natural elements in the residential environment affects the well-being of its users, thus translating into

its quality [3]. The dependence of humans and nature is therefore mutual, and the authoritative as well as destructive nature of human actions towards nature is a double-edged weapon. A consequence of analyses of the relationship between humans and nature is the subjective perception of nature as a living element with distinct needs, which may represent a conflicting interest in discussions of environmental transformations [8]. Provided the proper conditions and respect for the requirements of both of these sides, a compilation living environment can be a symbiotic form that combines the worlds of culture and nature [7].

In multifamily developments, with a cluster of dwellings, the possibilities for shaping the conditions for contact with the natural world beyond the development of the building's surroundings are limited. In the private space, within the apartments, the basic element is access to sunlight, which is necessary for the functioning, both of humans and animals and plants. The presence of natural light and fresh air in the living areas is a peculiar reminiscence of the open space experience. Architectural solutions that enable contact with the natural world are the implementation of balconies, terraces and winter gardens that enable spending time in the open air. Within such outdoor living spaces and in the light zones of the apartments there are also suitable conditions for the cultivation of greenery, which constitutes a substitute for the natural environment. The separation of residential structures from the outside world is not complete and the appropriate shaping of the relationship between the internal and external space of the building can create the right conditions for a state of symbiosis between culture and nature in the residential environment.

The global pandemic has imposed a remote organization of learning and work enabled by online forms of communication. Corridors of public buildings, offices, classrooms and conference rooms have been replaced by computer stations located in domestic spaces. More frequently than before, social interactions take place not in the physical space, but in the virtual one. Elizabeth Grosz calls cyberspace the most imaginative component of the Internet, emphasizing its parallel and equivalent nature [9]. Online meetings involve a kind of curvature of space, where users are simultaneously together and apart, in one and many places. The computer workstation becomes a portal to another reality, while the apartment becomes a synthesis of two parallel worlds [1]. Virtual space is an extension of urban space both in terms of preserving local character, enabling contacts within native communities, and by maintaining nodal properties analogous to urban nodes in terms of structure and mode of operation [10] [11].

The emanation of virtual reality in the residential space are networked devices equipped with screens, cameras, speakers and microphones: phones, tablets and computers but also projectors, TV sets and VR goggles. At varying levels

of engagement, from superficial browsing on a phone to immersive gaming in goggles and headsets, users function in a wide spectrum of positions between real and virtual realities [12]. In terms of housing design, simultaneous existence in both worlds requires specific physical space, rooms or zones that provide convenient conditions for all persons in the dwelling. Separate rooms for work and study are optimal, but some activities can take place within appropriately equipped common spaces, living rooms, or dining rooms. The residential space creates opportunities for symbiotic co-existence of real and virtual space, where both elements impose on each other remaining in a state of balance.

The architectural structure of residential buildings and the material divisions that form it are an emanation of the cultural state of inhabitation. Elements of nature and virtual elements occurring within the residential structures are permeable, have no clear barriers, accompany residents next to the real space and coexist with it simultaneously.

ADAPTATION OF APARTMENTS FOR THE PURPOSES OF COMPILATION DWELLING

"Drapacz chmur" residential building - dense layout

The silesian “drapacz chmur” (eng. skyscraper) was built between 1929 and 1934 as a building of the former tax office with a residential part for prominent employees. Its height of 62 m made it one of the highest buildings in Europe and the highest in Poland until the construction of the Warsaw Palace of Culture and Science in 1955. The functionalist project was developed by the architect Tadeusz Kozłowski, the constructor Stefan Bryła and the construction manager Henryk Griffel [13]. From the planning phase, the investment in Katowice at the crossroads of Żwirki i Wigury and Skłodowska-Curie Streets (formerly Zielona and Wanda Streets) was unique due to its innovative at the time steel frame construction, the use of which was intended to defy economic recession, promote modern technologies and emphasize the importance and potential of the Polish part of Upper Silesia [13]. The building was divided into two segments, a lower 6-story building housing the office function and a higher 14-story building with residential function.

Fig. 1. The building of the former tax office, a Silesian "drapacz chmur" in downtown Katowice
Source: photographs by the author, 2022

The apartments in the building are mostly of a high standard, the subject of analysis are the repetitive floors from the seventh to the ninth floor containing units with approximate areas of 30, 60, 80 and 120 m^2. The upper floors of the building have an L-shaped layout including a centrally located staircase with three elevators and an irregular corridor, as well as residential units arranged along the streets with a characteristic stepped facade and balcony layout emphasizing the corner. It is surprising that there is no balcony in the biggest apartment; the others have small outdoor spaces of about 3 m^2 accessible directly from the rooms and, in one case, from the corridor serving as a hallway. Sunlight reaches the building through all elevations, and there are windows in almost every room, including pantries and bathrooms (except for two of the three corridors). The structure of the almost ninety-year-old dwellings partly differs from contemporary standards, as it is indicated by the servants' quarters located next to the kitchens. Today, simultaneous virtual spaces can be superimposed on the existing structure, primarily within living and sleeping rooms, as well as dining rooms and relatively large, separate kitchen areas.

Fig. 2. Residential building at the crossroads of Żwirki i Wigury and Marii Skłodowskiej-Curie streets in Katowice - plan of the repetitive floor 7/8/9. Analysis of apartment structure with consideration of cultural, natural and virtual elements. Exemplary arrangement of rooms
Source: author's analysis based on technical documentation of the building [14] and in situ studies

Multi-family residential building "Superjednostka" - linear layout

Katowice's Superjednostka, located at 32 Korfantego Street, is the Polish answer to Le Corbusier's residential projects. Completed in 1972, the building designed by Mieczysław Król is almost 200 meters long and has sixteen storeys, including an underground one, containing seven hundred and sixty-two apartments, and being able to accommodate two thousand eight hundred and twenty-three residents [13] [14]. The analyzed fragment includes a repetitive module of six one-sided lighted apartments with access to characteristic, longitudinal balconies.

Fig. 3. Multi-family residential building commonly referred to as Superjednostka, Katowice
Source: photographs by the author, 2021

The structure of the surveyed apartments is repetitive, with mirror images of successive apartments used along the longitudinal axis of the building. The examined fragment contains two types of flats with one separate bedroom providing indirect light to a small kitchen, a bathroom, a hallway and a passable living room. The larger of the apartments has an additional utility room, but the spatial structure of the whole remains analogous. Natural elements within the analyzed apartments are concentrated along the outer edges of the building, starting from narrow balconies up to the directly sunlit living room and bedroom. Contact with the natural open space is provided by the penetration of interior spaces. Virtual elements may appear in apartments in the form of islands as zones occurring within rooms having multifunctional characteristics, that is, bedrooms and living rooms with dining areas. The areas that enable connections to the digital world have no defined boundaries; instead, they annex physical space for their purposes.

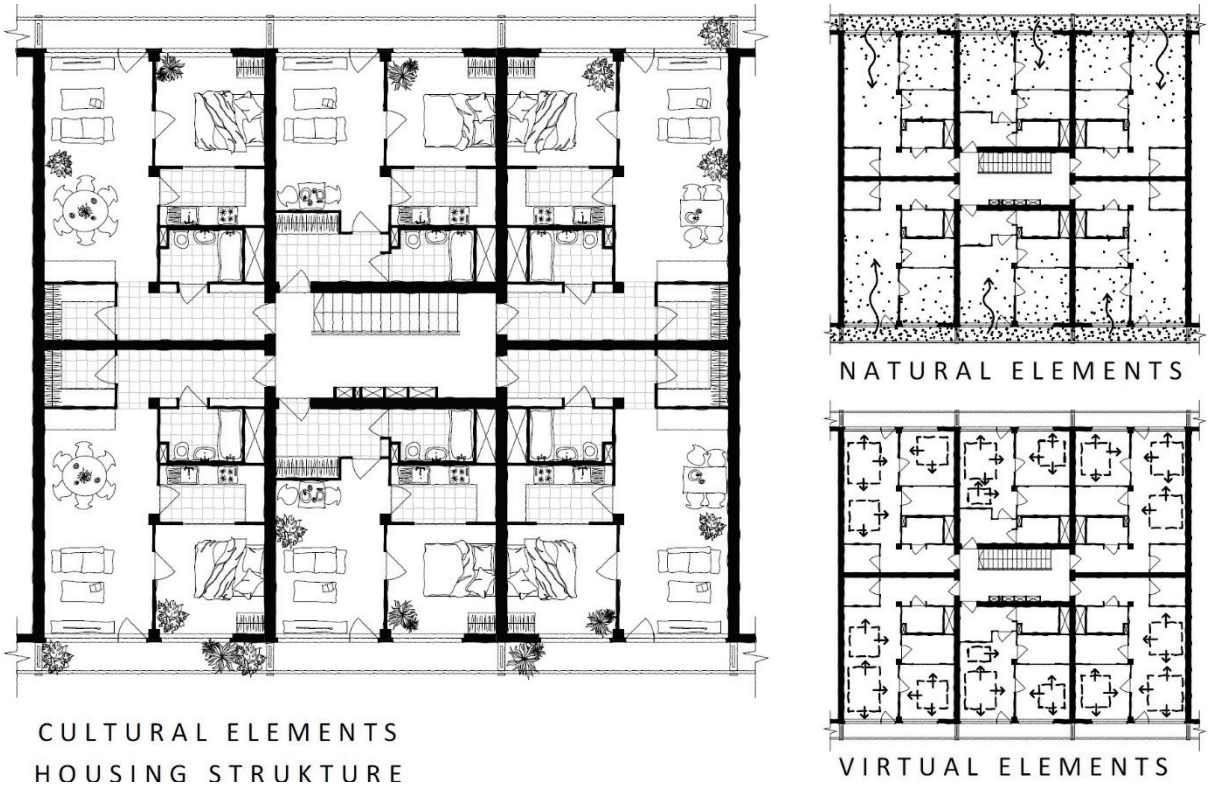


Fig. 4. Superjednostka building – a section of a repetitive floor. Analysis of apartment structure with consideration of cultural, natural and virtual elements

Source: author's analysis based on technical documentation of the building [15] and in situ studies

Multi-family residential buildings 'Kukurydze' - concentric layout

Designed by Henryk Buszko and Aleksander Franta, the octagon-shaped tower blocks with rounded balconies, commonly referred to as ‘kukurydze’, are one of the most characteristic buildings of Osiedle Tysiąclecia and the Silesian region [14]. In Katowice, in the Walenty Roździeński housing estate, there are their twin versions with trapezoidal balconies commonly referred to as "stars" [gwiazdy], both solutions were inspired by the Marina City skyscrapers in Chicago designed by Bertrand Goldberg [16]. The buildings come in two height variations: three buildings have twenty-five residential stories, the other two have fifteen stories each. The analyses include eight dwellings on a typical floor of the building. The apartments have a comparable structure: service rooms such as hallways, bathrooms, and kitchens in various arrangements, with or without dining areas, are concentrated along the corridor.

Fig. 5. Multi-family residential building commonly referred to as Kukurydza, Katowice
Source: photographs by the author, 2021

The living area in each example is located in a square module protruding from the building facade and containing an oblong living room and two bedrooms, one accessible directly from the corridor and one accessible through a passageway. Each of the apartments has two semicircular balconies, which provide light to living rooms and bedrooms. Despite their shallow depth, the balconies connect the apartments with the natural outside environment [17]. Most units have natural light in the kitchen areas. Likewise in the other examples, the natural world penetrates the building structure from the exterior facade to the interior. Virtual elements can occur within multifunctional bedrooms and common areas of living room, dining room and kitchen. Workstations for remote work and learning as well as digital entertainment occur at multiple locations with no defined boundaries, forming an integral and multifunctional element of the apartments' interiors.

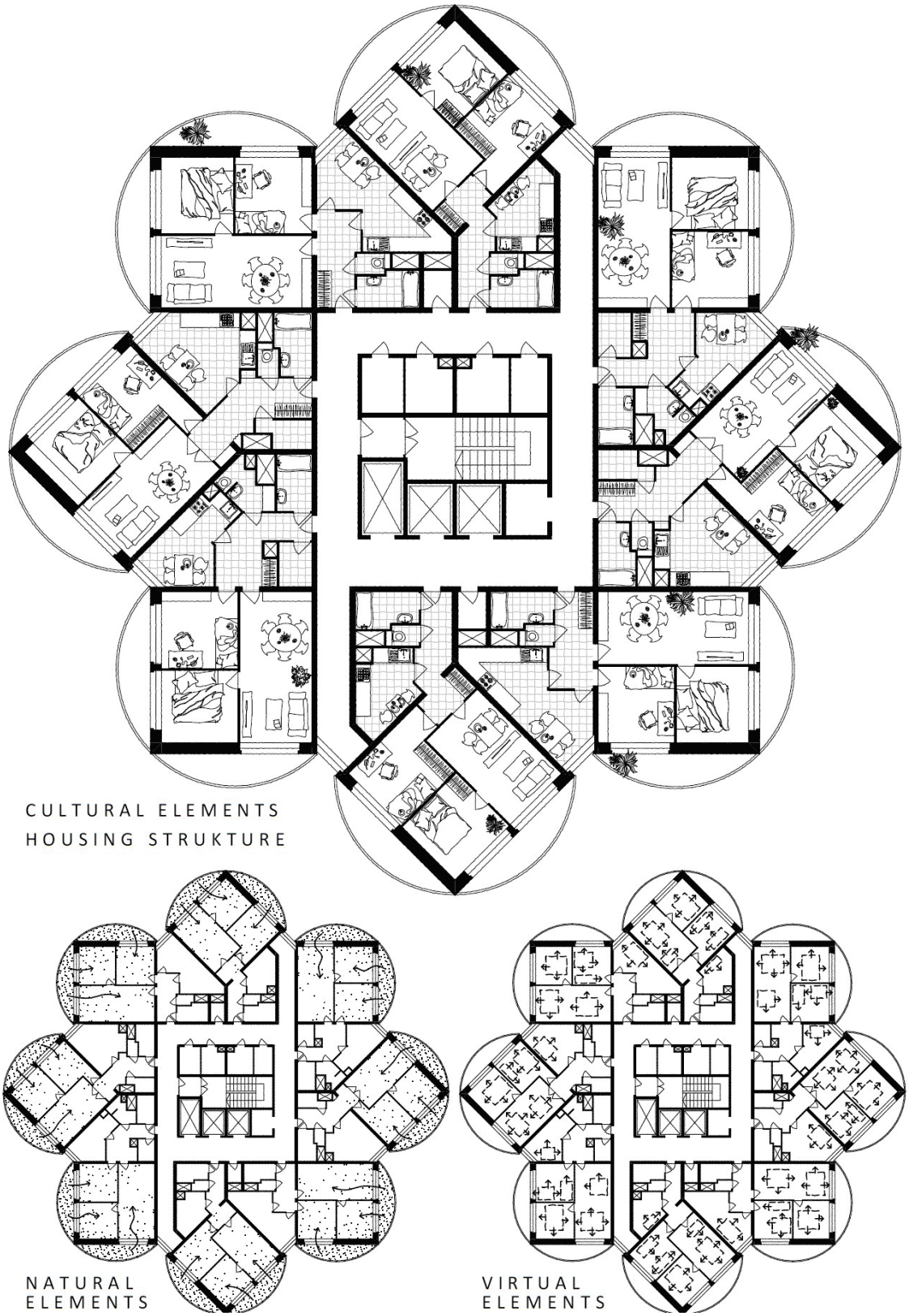


Fig. 6. Kukurydza building – a repetitive floor plan. Analysis of apartment structure with consideration of cultural, natural and virtual elements

Source: author's analysis based on technical documentation of the building [16] [18] and in situ studies

CONCLUSIONS FROM THE COMPARATIVE ANALYSIS

The residential structures surveyed represent three different concepts of shaping the building volumes, which is reflected in the way the building's relationship with its surroundings is formulated. Noticeable consistency in constructing the external silhouette of each building is achieved in two ways: in the case of the "drapacz chmur", both the layout of communication and apartments is irregular while maintaining rigor in forming the symmetrical layout of balconies and corners of the facade, in the other two cases, the entire storey compositions remain strictly ordered and repetitive. As a result, the later developments provide comparable contact with nature for all residents, while in the skyscraper one of the analyzed apartments has no access to the private outdoor space. On the other hand, the presence of natural light in the vast majority of rooms and the possibility of at least corner ventilation of the apartments, analogous to the buildings from Osiedle Tysiąclecia, speak in favour of the oldest of the surveyed buildings.

The virtual aspect of smart living can be implemented in each of the analyzed apartments without any changes in the room layout. New technologies appear in living spaces successively complementing existing equipment. Assuming that each resident needs a personal space for remote work, study or entertainment and virtual meetings in digital space, the matter of adapting existing structures to post pandemic needs is reduced to the account of separated spaces. For individual activities, each user requires their own room. The optimal solution is a dedicated room or a private bedroom with an ergonomic area equipped that includes a work desk. Alternative solutions are appropriately arranged places within living or dining rooms, enabling comfortable use of devices allowing for functioning in virtual reality. The above criteria are met by the ratio of 1 person in a one-bedroom apartment, and subsequently one additional bedroom for each additional resident, maintaining the regularity that one of the bedrooms is always double. Thus, the fulfillment of optimal spatial conditions for functioning in virtual dimension is fulfilled in all studied examples, preserving the assumed arrangement and the associated number of residents. The aspect of adapting existing structures to the needs of smart living is flexible and thus also easier to implement than the access to nature, which is limited by the imposed building structure.

In analyzed cases, natural and virtual elements complement and enrich the physical living structure, making it a multidimensional platform for daily activities. In addition to the natural elements that have always been present in living space, new virtual elements are now an essential component of habitation. Existing residential structures can be adapted to modern smart city requirements by introducing multifunctional zones for individual users and group activities. In a post-pandemic reality, smart cities are faced with the need to organically adapt to changing conditions, which can be achieved through adding new functionalities to

existing structures. Optimal concepts maintain a balance between the cultural, natural, and virtual components of the living space.

SUMMARY

The pandemic crisis has affected all areas of life, leaving its mark also on the residential environment. Increased usage of residential spaces associated with pandemic restrictions is a peculiar anomaly in the natural processes of change concerning habitation, forcing a reevaluation of applied solutions. The crisis conditions exposed compromises based on optimistic scenarios, revealing their original flaws. On the one hand, modern information technology has made it possible to work and study remotely in domestic spaces; on the other hand, residents have been shackled in settings that have become crowded prisons devoid of the contact with nature that residents need. Post-pandemic reality requires a multidimensional space of inhabitation - a platform for activities associated with dwelling, combining elements of the cultural, natural, and virtual worlds. Compilation inhabitation defined by Grzegorz Nawrot [1] can provide a response to the revised requirements for housing in the context of smart cities.

Analyses of selected examples of multi-family housing in Katowice show that there are possibilities of adapting the existing solutions to the needs of compilation housing. Within the framework of existing structures there are natural elements or possibilities of their arrangement, while virtual elements in a semblance are imposed on the physical space in the form of zones and stations that enable connections to the network and the digital world. The effectiveness of the presented solutions depends on the amount of available space for each resident and potential multifunctional solutions. Within the analyzed structures there is a regularity that the elements of the natural world penetrate the interior of the building through balconies, loggias and terraces, as well as sunny rooms, while virtual elements in the form of zones allowing connections with cyberspace are of an insular nature and occur within living spaces. Both elements exist in parallel in cultural space complementing it with supplementary, simultaneously functioning dimensions. Post-pandemic living spaces in smart cities are flexible structures capable of adapting to changing circumstances.

BIBLIOGRAPHY

1 Nawrot G.: „Symultaniczność i kompilacja a obraz miejsca," Budownictwo i Architektura, nr 18 (2), 2018, pp. 29-38.

2 Trautsolt-Kleyff K.: Wzory kulturowe użytkowania i urządzania mieszkań. Potrzeby rodzin a koncepcje projektowe, Instytut Wzornictwa Przemysłowego, Warszawa 1985.

3 Sim D.: Miasto życzliwe. Jak kształtować miasto z troską o wszystkich, Wysoki Zamek, Kraków 2020.

4 Kowalska-Styczeń A.: „Badanie złożonych zjawisk społecznych w kontekście inteligentnego miasta," [w:] Inteligentny rozwój inteligentnych miast, CeDeWu Sp. z o.o., Warszawa 2020, pp. 137-146.

5 Ingold T.: Splatać otwarty świat. Architektura, antropologia, design, Instytut Architektury, Kraków 2018.

6 Nawrot G.: „Constans w architekturze," Pretekst. Zeszyty Katedry Projektowania Architektonicznego, nr 10, 2020, pp. 27-32.

7 Leśniakowska M.: „Zamieszkać z drzewem, czyli architektura w ogrodzie ekokrytyki," [w:] Architektura jest najważniejsza. Tom 4. Drzewa, EMG, Kraków 2018, pp. 29-48.

8 Rylke J.: „Drzewo w modernizmie," [w:] Architektura jest najważniejsza. Tom 4. Drzewa, EMG, Kraków 2018, pp. 49-74.

9 Grosz E.: Architecture from the Outside: Essays on Virtual and Real Space, Massachusetts, The MIT Press Cambridge, London 2001.

10 Ilnicki D., Janc K.: „Węzłowość i przestrzeń przepływów Internetu: ujęcie globalne i lokalne," Geopolis – Elektroniczne Czasopismo Geograficzne, 2008, pp. 5-23.

11 Zuziak Z.K.: „Węzły miejskości a modele przestrzenne struktur miejskich. Z notatek nt. synergii w urbanistycznych konstrukcjach śródmieść," Budownictwo i Architektura, 2018, pp. 107-129.

12 Śliwa A.: „IT technologies in architecture and space representation. Bruno Zevi methods revisted," Architecture Civil Engieneering Environment, Tom 1 z 2 Vol. 12, no. 3, 09 2019, pp. 35-40.

13 Kozina I.: Ikony architektury w województwie śląskim w XX i XXI w., Muzeum Śląskie w Katowicach, Katowice 2019.

14 Kozłowski T. i Bryła S.: „Projekt katowickiego "Drapacza chmur" – rzut 7, 8 i 9 piętra," 1930. [Online]. Available: https://www.sbc.org.pl/dlibra/publication/373382/edition/352624. [Data uzyskania dostępu: 4.03.2022].

15 Opracowanie zbiorowe pod redakcją Hanny Kostrzewskiej, Rajza po Kato. Przewodnik po Katowicach, Kraków: Fundacja Sztuk Wizualnych, 2015.

16 Springer F.: „Źle urodzone. Reportarze o architekturze PRL-u," Wydawnictwo Karakter, Kraków 2017.

17 Król M.: „Projekt techniczny budynku mieszkalnego "Superjednostka"

w Katowicach – rzut piętra," [Online]. Available: https://www.sbc.org.pl/dlibra/publication/370678/edition/350194/content. [Data uzyskania dostępu: 2.11.2021].

18 Buszko H.: Moje rozmyślania o mieszkaniu, Wydawnictwo Arkady, Warszawa 1982.

19 Buszko H., Franta A.: „Projekt techniczny wieżowców mieszkalnych "Gwiazdy" w Katowicach – rzut typowej kondygnacji", [Online]. Available: https://www.sbc.org.pl/dlibra/publication/370689/edition/350204/content. [Data uzyskania dostępu: 2.11.2021].

Ivona DLÁBIKOVÁ[7], Martina PEŘINKOVÁ, Jan KOVÁŘ

DEVELOPMENT OF GRAVES AND BURIAL RITUALS IN EUROPE BEFORE THE GREAT ROMAN EMPIRE

PREHISTORY

The oldest finds of prehistoric cultures were discovered through the existence of tombs. Today, tombs serve archaeologists as the greatest source of information about the lives of our ancestors. In France, near the settlement of Le Moustier in the valley of the river Vézere, the body of an 18-year-old Neanderthal man was found: "…he was lying on his right side, his head resting on his forearm; as if sleeping quietly. Flint tools and stone fragments had been placed near his head…" [1]. The site was dated at about 45,000 years old, and all circumstances documented the respect of the bereaved for the dead. Dolní Věstonice in the Czech Republic is an important settlement location from the period 20,000–30,000 years ago. In addition to the many bones, graves, atypical triple graves and bones of mammoths, who were still alive at that time, many figural statuettes were found as well. The figures were carved from ivory or modelled from clay, an example of the prehistoric ceramics. In addition to animal figures, the well-known Věstonice Venus, a ceramic statuette with distinctive feminine curves, was also found there. The cult of a woman at the head of the society is also demonstrated by other prehistoric statuettes: the figure of a woman with her head turned upwards and her hands in a gesture of prayer was found in Hluboké Mašůvky, a seated figure of a woman was found in Nitra, and a ceramic vessel with feminine shapes was discovered in Svodín, etc.

The cult of ancestors is probably also evidenced by cups in the form of heads, female statuettes, and stone slabs with engraved eyes and chins." [1]. The depiction of a specific person was considered a rarity at the time, an actual portrait was taboo, yet portraits of specific dead persons had been found in the cities of Catal Huyuk and Jericho. Portraits of people around 6,000 years old have also been found in Michaľany in Slovakia, but even though the faces are depicted with their eyes closed, their funerary purpose is still debated. In Varna in Bulgaria, approx. 4,500 BCE, an important burial ground with much gold jewellery and weapons was found:

[7] VŠB - Technical University of Ostrava, fakulty of civil engineering, department of architecture (Czech Republic), ivona.dlabikova@vsb.cz

“Interesting here are the symbolic graves, the cenotaphs, almost 30 were found, which did not contain any bodies, but had all the honours associated with departure to the next world.” Apparently, this has to do with the belief that the soul of the deceased returns home, and if it cannot find its grave, harms those who forget to honour the deceased.” [1]. The Varna society had already been organised into social classes, as evidenced by a variety of graves of rich and poor. The rarest treasure was found beneath the barrow containing the tomb of a man whose body was almost entirely covered with gold. The man’s arms were crossed over his chest, and in his right hand he held a hammer axe. It was an inactive yet dignified position, reminiscent of how symbols of power were placed near Egyptian pharaohs. A large, temporal location and cultural distance although exists between the Varna men and the pharaohs, and it is difficult to compare them. The important finding was that the people ruled with the aid of a weapon of purely symbolic value. The second important finding was that a woman at the head of the society was replaced by a man [1].

CENTRAL EUROPE AND MEGALITHIC CULTURE

Megalith structures are typical for the neolith period and some of them are considered as graves, but the function is still discussed. The burial function had mainly megaliths called dolmens (Figure 1).

Fig. 1. The dolmens in Mané-Karioned belong to a group of Carnac dolmens and are dated at around 3,500 BCE, two dolmens were opened to the south, and the third dolmen at right angles to them is in the centre

Source: drawing by Ivona Dlábiková

In its chamber were often found skulls and bones in high number. However, nobody knows if it was the original function, or the burials were performed in later periods, so these buildings were just reused for other purpose.

The Radiocarbon dating showed a wide period during which were dolmens built: from 4800 to 1200 BC in Europe [2]. The type of building technology is still not clarified, even if some works proposed method for semi monolithic dolmens [3], the building method of structures made of solid rocks are still not explained. The most famous dolmen site in Europe is in France, Carnac, dating from 3,000 BCE. A dolmen is a corridor stone tomb [4], mainly built from granite rock or sandstone. We do not have many records of the culture of megalithic structures. Important point is, that dolmens were built all over the world in early Neolithic times: South Korea, India, China, Russia, North Africa, Italy, USA, Arabian Peninsula, Great Britain and already mentioned France. Some dolmens have engraved lines, the most developed were in Gavrinis tombs, but they were found in other dolmens as well (Figure 2).

After 1200 BC Dolmens were not built anymore, they were probably not needed or were replaced with another structure.

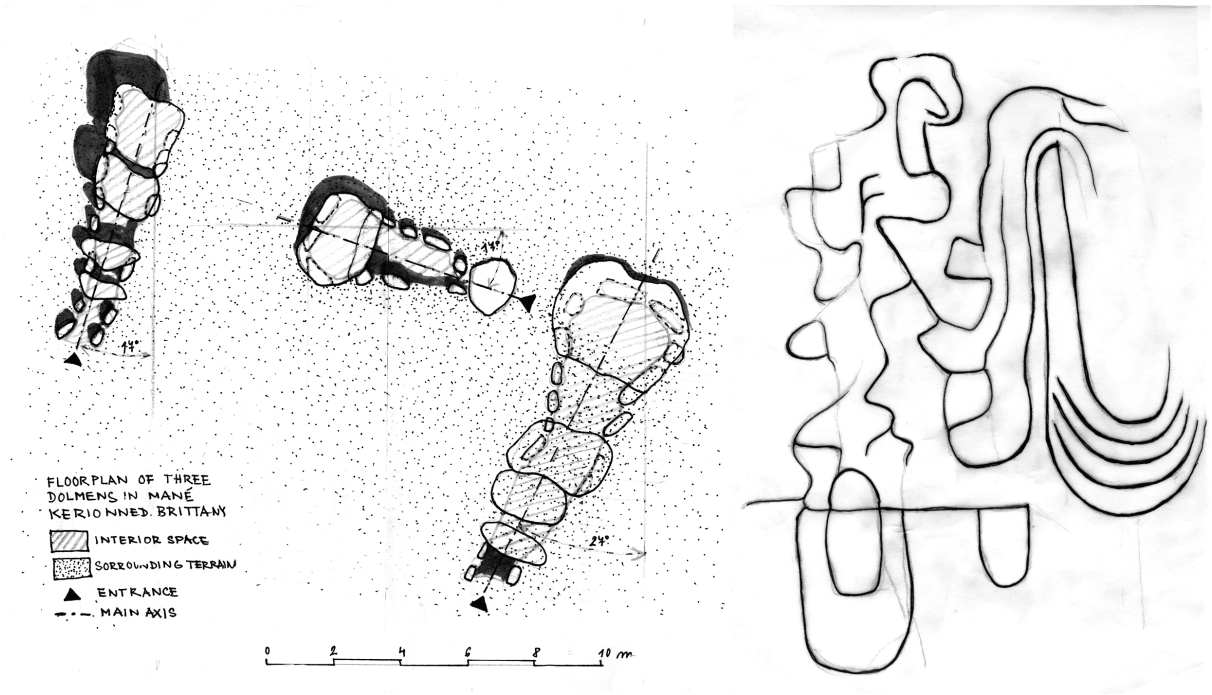


Fig. 2. Picture on the left side shows the floorplans of dolmens in Mané-Karioned, two dolmens were opened to the south, and the third dolmen at right angles to them is in the centre. Picture on the right represents simplified pictures of lines engraved on the stones at the entrance and in the corridor. The meaning remains unexplained but possibly represents a labyrinth or snake.
Source: drawing by Ivona Dlábiková

MYCENAE AND ANTIENT GREECE

The type of graves developed in Mycenae was so called beehive tomb also known as tholos tomb, for burying elite people. The grave was dug into a slope and supported inside with a false dome and the structure resembled a beehive. The most famous of them is Treasury of Atreus, which was "built of hammer-dressed and sawn conglomerate" [5], "huge **ashlar masonry** would be employed to create a conical structure, with a wide entryway leading to it, known as a dromos" [6]. The method of spanning or roofing spaces by means of corbelling has recommended itself quite widely to primitive people [7]. Corbelling is an overlapping arrangement of bricks or stones in which each course extends farther out from the vertical of the wall than the course below, with the cap stone at the top. Considering the dimensions of these tombs that people do not seem primitive at all. The important architectural and static feature in the entrance to the tomb was lintel, there was often the relieving triangle above the lintel to prevent the broke as it happened for example in the tomb of Aegisthus [8]. The entrance in Atreus tholos tomb from 1350 - 1250 BC was spanned by a single lintel stone, thought to weigh over 120 tons [6]. The tomb of Atreus was previously filled with expensive, mainly golden articles, the entrance was lined with alabaster, and all beautiful art was stolen or taken to museums abroad (Figure 3).

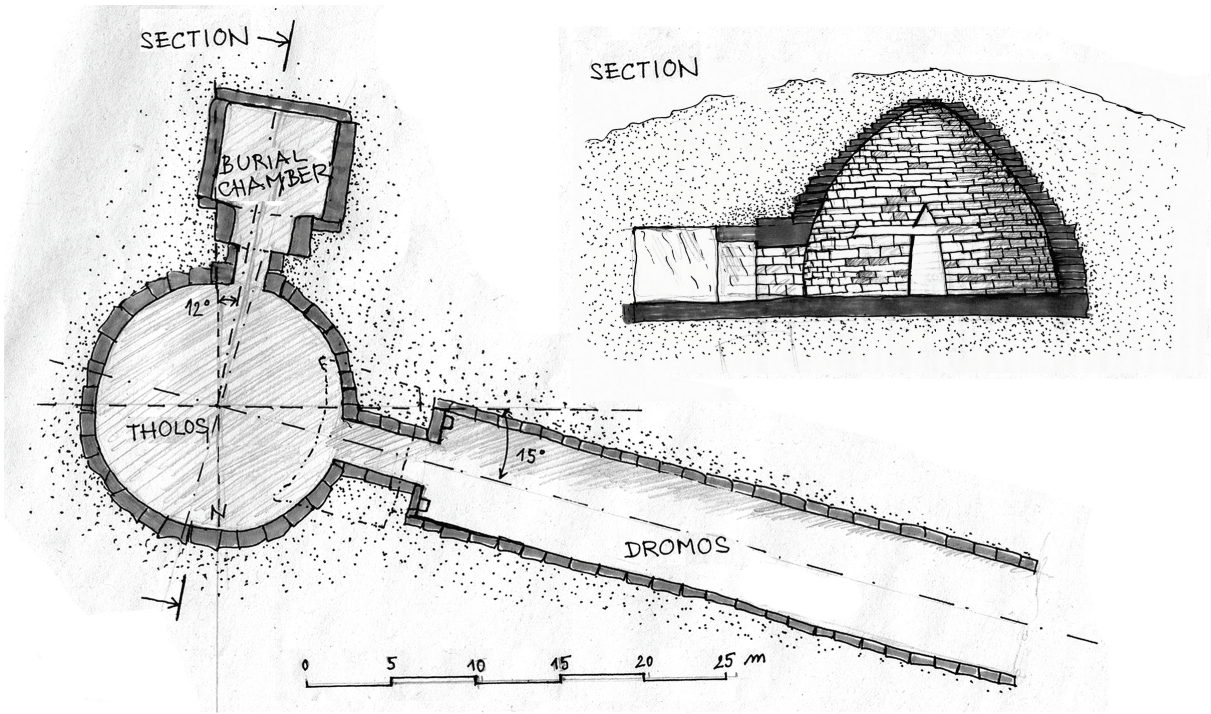


Fig. 3. The floorplan and section of Atreus tholos tomb
Source: drawing by Ivona Dlábiková

Mycenae is also known for the megaron type of structures, from which was later developed the temple of God. By adding columns around. The relation of grave to these temples are not known, Homer mentioned burial of Elpenor in Odyssey, but there was not mentioned shrine or temple. The temples served the gods, and only consecrated people could enter them. The public was only permitted at the front of the temple. It was the gods who decided on punishment if a man was not properly buried. Homer's Odyssey, from the 3rd century BC, described a situation where Odysseus' brother in armour Elpenor drank too much wine, fell off a roof, and broke his neck, but there was no time to build a grave for him and mourn him. When Odysseus descended to the house of Hades to where the dead live in the underworld "The first to come was the spirit of my comrade-in-arms Elpenor: '...There, then, O prince, I bid thee remember me. Leave me not behind thee unwept and unburied as thou goest thence, and turn not away from me, lest haply I bring the wrath of the gods upon thee. Nay, burn me with my armour, all that is mine, and heap up a mound for me on the shore of the grey sea, in memory of an unhappy man, that men yet to be may learn of me. Fulfil this my prayer and fix upon the mound my oar where I rowed in life when I was among my comrades.' [9]. English philosopher Roger Scruton noted that Elpenor not only asks to be buried, but also asks people to cry over him [10] (Figure 4). And Odysseus knew what he was expected to do: he had to cremate Elpenor's body, weep over his death and erect a memorial.

The unborn are of vital importance to this sacrifice of the dead, and by honouring Elpenor, Odysseus also acted for "those who come after us". He acted in a way that was immediate to Odysseus' perception, with Odysseus' own love for his family and respect for the father who raised him. The common culture encompasses these complex states of mind and enforces their validity [10]. The funeral was guaranteed not only because of fear of the gods but also the law, for example, during the reign of Solon. He decided on the number of inhumations and cremations. He also ordered that a visitation (exposition, in Greek πρόθεσις – prosthesis, pro-ante, thesis-placement, location in front of, or in public view) of the deceased should take place inside the house. Among the Athenians, children, even those who were relieved of all other duties in respect of unworthy parents, were obliged to bury their ancestors [11]. Common terms for funeral rites, τὰ δίκαια (fair, just), νόμιμα (lawful, legal) or νομιζόμενα (far-sighted, attentive), προσήκοντα (appropriate, proper), indicate that the dead had a legal and moral right to a burial.

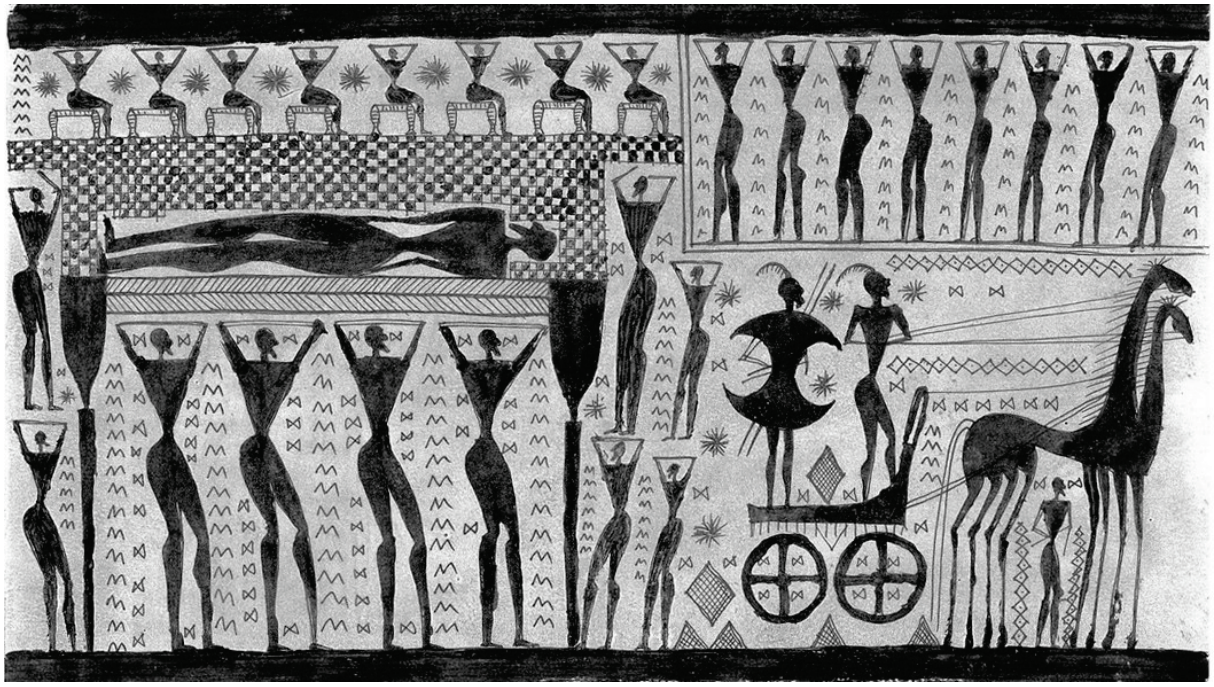


Fig. 4. A funerary vase called a krater was a vessel to mark the grave of a man, an amphora for a woman. The catafalque is surrounded by family, friends and professional mourners, who sit or kneel with their hands raised above their heads in a gesture of grief

Source: Drawing by Ivona Dlábiková, adopted according the fragment of a crater, Archaic Greek Art 700-600 BCE, Louvre

CELTIC CULTURE

At the end of the third millennium BCE, in the late Stone Age in the West, the megalithic culture with its menhirs, dolmens and cromlechs weakened.

Many Celtic iconographies point to the interconnection of everything (Figure 5), where everything is intertwined with everything else, including intricate ornaments without end, such as the delicate bronze work on the door knocker of Dunor, Ireland, from the eighth century BCE, with a lion's head and intertwined spiral scrolls [12]. The very term 'army' used to express 'people' shows the true nature of Celtic society, in which the individual is set within his tribal framework. How could such a person adjudge his struggles with any individual attributes that he did not realise nor experience himself? Caesar's mistake was to attribute the names of Roman gods, whose individual actions could not correspond to the collective actions of the Celtic gods, to the Gallic gods," [13].

This sensitive idea was replaced by the Roman dictatorship, falling in 124 BCE into the hands of the legions of Provence. The lack of solidarity in the Celtic tribes encouraged Caesar to prepare for and wage a Gallic war, which ended with the defeat of Vercingetorix in Alesia in 52 BCE. The dwellings characteristic of this culture were the Celtic oppida, on the ridge of an enclosed ancient village. To this day, their

foundations can be seen in France, Britain, Germany, Switzerland, Austria, the Czech Republic, Slovakia and other countries. The oppidum in Glauberk, Germany, dates to the Hallstatt and early La Tèn cultures; originally the fortification of the oppidum was attributed to the Romans, but after finding the gold *torq (torque or torc)* necklace and other objects from the fourth century BCE, it was clear that it had been a Celtic seat. The excavations first focused on the fortification structures, discovering only a later circular moat with a tomb, called a tumulus. Next to the tomb was a life-size statue of the Celtic Prince of Glauberk, made of sandstone, armed with a wooden shield, tunic and a typical La Tén sword [14]. The tumulus contained three chambers: an empty pit in the centre, perhaps a preventive measure against tomb raiders, a chamber for burial in the form of inhumation, and one small chamber for burial after cremation. Interring cremated remains was more common in the Hallstatt culture, while inhumation was more characteristic of the later La Tèn culture.

The relation between tumulus and shrines or kind of sanctuaries is not known. In some cases, the shrines or temples were placed inside Celtic Oppidum [15], but there were cases when any shrine was not discovered in the oppidums [16]. Moreover, separated sacred places were found. According Fernandez-Gotz [17], there were two types of Oppidums: the economic ones and political-religious ones. But the Oppidum (large, fortified Iron age settlement) were built from 2nd century BC north of the Alps [18] and it was not the only type of settlements during Celtic period as was described by Buchsenschtz, Gruel and Lejars: “Villages were rare in the fourth and third centuries BC and open or fortified settlements the exception. Dispersed collections of dwellings largely predominated. These farms usually comprised several buildings serving distinct purposes — the home, a place for livestock, and workshops — built side by side in an enclosure.” [19]. According to Fernandez-Gotz [17] ,,the shrines could be also part of dwellings: 1. the great sanctuaries of Picardy, Gournay-sur-Aronde and Ribemont-sur-Ancre, which drew attention to the existence of clearly defined La Tène places of worship equipped with buildings. 2. the re-evaluation of the Viereckschanzen, which are today seen mainly as residential enclosures, whose functions could sometimes include certain cultic practices, as seen in Fellbach-Schmiden or Mšecké Žehrovice.”. The excavations in Manching oppidum showed, that one burial site was directly inside settlement, close to shrine and Temple, but there were also second groups of graves in a bigger distance from shrine and still inside the oppidum and the third group of graves outside the oppidum in bigger distance behind the river [16].

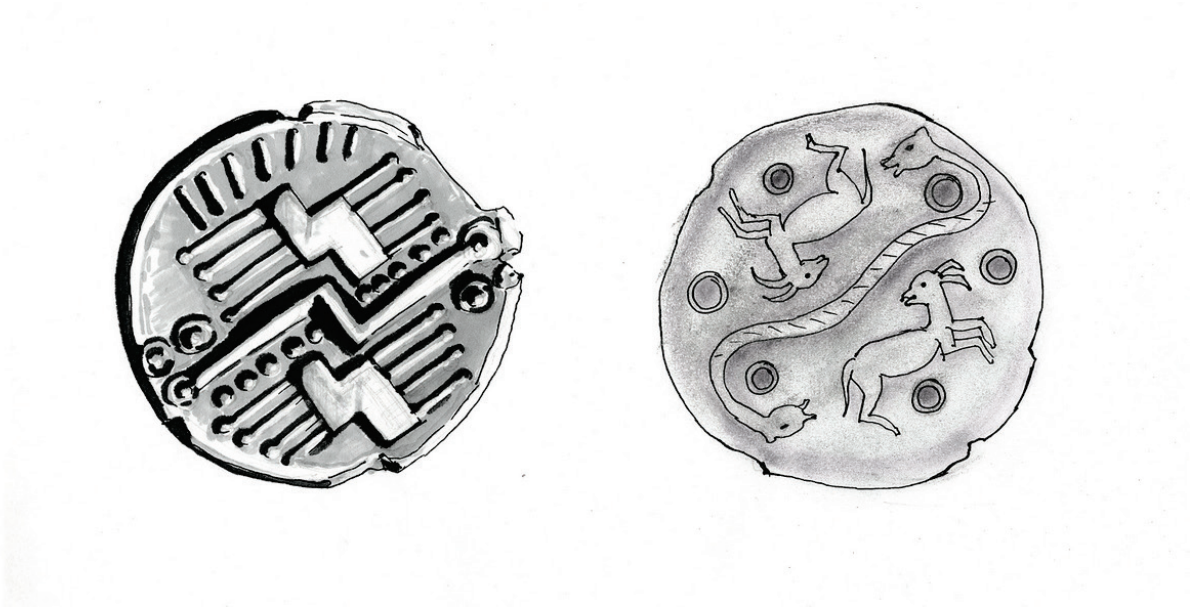


Fig. 5. The Celts were masters of symbolism and symbolic signs. The abstraction can be seen in this coin and its realistic version alongside, depicting the same motif of a double-headed snake, representing life and death, and two goats, symbolising fertility
Source: Drawing by Ivona Dlábiková, drawing and commentary adopted from [13]

SUMMARY

In cultures presented in this text can be seen similar attitudes to death, the rituals have to be performed to ensure a good departure. The philosopher Arnold van Gennep [20] describes the rituals of passage from one state to another, so the man has to be just prepared for a type of journey. This opinion is declared by the architecture of historical graves, for example, dolmen made by megalithic culture has a corridor and the chamber in the end man must make some journey first and then be buried. In the case of a tumulus built by Celtic culture, the artificial mound was made, and the grave is situated inside after a long corridor. In Greek culture the procession went with the body of deceased and then was buried or cremated. The journey is present everywhere. The grave was often represented by artificial cave as it was in the case of dolmen or tumulus. In Greek culture was the world of dead situated in an underground empire. Therefore, the idea of underground world is common for these three cultures, even though interpreted by different architecture.

Another question was what happened to these buildings after the cultures disappeared or were just abandoned? In history there were many examples of reusing the architecture for a new purpose. In Brittany, for example, were some megaliths of Dolmen de Crucuno cut and used for neighbouring objects. Dolmens were also used many thousand years and the usage as a grave could be only secondary function after the original one. Some people were trying to continue in

megalithic spirituality, for example in Stonehenge, where the solstice is celebrated every year. In the case of tumulus, the artificial mound ensured the grave will be never found, only accurate observation and modern geology tools recognized small artificial hills in the last centuries. These examples of tombs survived many crises, climatic or social, but it stands until today.

BIBLIOGRAPHY

1. Dvořák P.: Traces of the antient past, Slovakia in prehistory. Printers BB, Banská Bystrica 2002.
2. Schulz Paulsson B.: Radiocarbon dates and Bayesian modeling support maritimediffusion model for megaliths in Europe. In Proceedings of the National Academy of Sciences [online]. 2019, 116(9), 3460-3465 [cit. 2021-12-06]. ISSN 0027-8424, doi: 10.1073/pnas.1813268116
3. Sharikov Y.N. Yakobson K.E., Komissar O.N., Kusmin Y.V., Jull E.G.T.: Investigations, Reconstruction and Geological Aspects of Dolmen Construction Technology in the North-West Caucasus. Archaeology 2013; 2(2): 38-46. doi: 10.5923/j.archaeology.20130202.04
4. Lauda L.: Dějiny architektury 1. Ústav pro učebné pomůcky průmyslových a odborných škol v Praze, Praha 1946.
5. Wace A.J.B.: The Date of the Treasury of Atreus. The Journal of Hellenic Studies, Vol. 46, 1926, pp. 110 - 120. Doi: 10.2307/625574
6. Biers W.R.: The Archaeology of Greece. Ithaca: Cornell University Press, 1980.
7. Cavanagh W.G., & Laxton, R.: The Structural Mechanics of the Mycenaean Tholos Tomb. The Annual of the British School at Athens. Vol. 76, 1981, pp. 109 - 140.
8. Galanakis Y.: The Construction of the Aegisthus Tholos Tomb at Mycenae and the "Helladic Heresy." *The Annual of the British School at Athens*,. Vol. *102*, 2007, pp. 239 - 256.
9. Homer: The Oddysey. Penguin Classics, London 1996.
10. Scruton R.: An Intelligent Persons´s guide to Modern Culture. St. Augustine´s Press 2000.
11. Aeschines: Against Timarchus. Harvard University Press, London, 1919.
12. Koch J.WT.: Celtic culture, a historical encyclopaedia. ABC-CLIO, 2006.
13. Lengyel L.: Le secret des celtes. Robert Morel, Les Hautes Plaines de Mane, 1969.

14. Herrmann F.R.: Der Glauberg am Ostrand der Wetterau: Fuhrungsblatt zu den Wallanlagen und dem fruhkeltischen Furstengrabhugel beu Glauburg-Glauberg. Welleraukreis, Wiesbaden 2014.
15. Zapatero G.R., Álvarez-Sanchís J.R., Rodríguez-Hernández J. : Urbanism in Iron Age Iberia, Two Worlds in Contact. Journal of Urban Archeology. Vol. 1, 2020, pp. 123 - 150. Doi: 10.1484/J.JUA.5.120913
16. Stoddart S.: Delicate urbanism in context: Settlement nucleation in pre-Roman Germany. The DAAD Cambridge Symposium, University of Cambridge. ISBN: 978-1-902937-83-0
17. Fernández-Götz M.: Sanctuaries and ancestor worship at the origin of the oppida. In Proceedings of the International Colloquium Buzău (Romania) 23rd-26th October 2014, County Museum.
18. Besse M. et al. : Funerals During the Second Iron age: A Newly Discovered Sepulchral Ensemble Reveals Practices in Western Switzerland (Pré-Du-Stand, Geneva). Journal of Anthropological and Archeological Sciences, Lupine publishers, 2021. Doi: 10.32474/JAAS.2021.04.000198ff
19. Buchsenschutz O., Gruel K., Lejars T. : The Goldem Age of the Celtic Aristocracy in the Fourth and Third Centuries BC. Annales.Histoire, Sciences Sociales, Vol. 67(2), 2012, pp. 185-215. ISSN 2268-3763.
20. Gennep V.A.: Les rites de passage. Éditions A. Et J. Picard, 1909.

Tomasz WAGNER [8]

ESTABLISHMENT AND IMPLEMENTATION OF THE EHTIC EDIFICE AT THE CAMPUS OF THE SILESIAN UNIVERSITY OF TECHNOLOGY IN ZABRZE. ICONOGRAPHIC PROGRAMME OF THE BUILDING INTERIOR (2020/21) AS AN EXAMPLE OF A SYMBOLIC PANDEMIC-ERA COLLAGE

Innowacyjne technologie są otwarciem nowych horyzontów w medycynie. Niosą one wielkie nadzieje pacjentom, pozwalają oszczędzić im cierpienia, wcześniej rozpoznać zagrożenie chorobowe, przyspieszyć i usprawnić terapie, skutecznie interweniować w przypadkach, które jeszcze do niedawna wydawały się całkowicie niemożliwe do uleczenia. Są to ogromne szanse I ogromne korzyści, zarówno dla każdej z osób dotkniętych cierpieniem, jak również dla całego społeczeństwa. Dlatego wszelkie badania naukowe i zastosowania praktyczne służące rozwojowi innowacyjnych technologii powinniśmy traktować jako długofalową inwestycję o wielkim znaczeniu.[9]

Innovative technologies open up new horizons in medicine. They bring great hopes to patients, make it possible to spare them suffering, recognize the risk of disease earlier, speed up and improve therapies, and effectively intervene in cases that until recently seemed completely impossible to cure. These are tremendous opportunities and enormous benefits, both for everyone affected by suffering and for society as a whole. Therefore, all scientific research and practical applications serving the purposes of the development of innovative technologies should be treated as a long-term investment of great importance.

President Andrzej Duda

1. INTRODUCTION

1.1 Genesis of the construction of the laboratories of the Faculty of Biomedical Engineering – the present-day EHTIC edifice in Zabrze

The Faculty of Biomedical Engineering of the Silesian University of Technology was established in 2010. Upon a motion submitted by His Magnificence, Vice-chancellor, Professor Andrzej Karbownik on 26 April 2010, the university's governing body Senate passed the Resolution on the establishment of the first-in-Poland Faculty of Biomedical Engineering at the Silesian University of Technology, as of 1 May 2010[10]*.*

[8] Tomasz Wagner, PhD (DSc) Hab. Eng. Arch., Professor of the Silesian University of Technology, Faculty of Architecture, Department of Housing and Public Architecture Design RAr-2 (Politechnika Śląska, Wydział Architektury, Katedra Projektowania Architektury Mieszkalnej i Użyteczności Publicznej). Address: ul. Akademicka 7, 44-100 Gliwice; E-mail: tomasz.wagner@polsl.pl

[9] a fragment of the speech delivered by Andrzej Duda, the President of the Republic of Poland, on 4 October 2021, during the opening ceremony of the EHTIC edifice. Source: KPRP.

[10] Marciniak Jan, Paszenda Zbigniew, *Historia Wydziału Inżynierii Biomedycznej Politechniki Śląskiej (The History of the Faculty of Biomedical Engineering at the Silesian University of Technology)*, Zabrze, 2020, a digital document: www.polsl.pl/rib/wp-content/uploads/sites/84/2020/12/Historia-Wydzialu-IB.pdf, p. 3 [access: 15.12.2021].

The Faculty Council endorsed the organizational structure of the unit and elected its dean on 26 September 2011. The person nominated as the first Dean of the Faculty of Biomedical Engineering was Professor Ewa Piętka[11]*.* For the first several years the Faculty used the classrooms and laboratories of other faculties located at the university campuses in the cities of Gliwice and Zabrze. On *16 May 2012, the Faculty Council elected a new Dean of the Faculty of Biomedical Engineering for the term of office 2012/16, (...) Marek Gzik, Prof. Extraordinary, PhD (DSc) Hab., Eng.*[12] He held the position of dean until the year 2020. The authorities of the city of Zabrze decided to hand over some facilities to the Silesian University of Technology. The facilities, located on the premises of the former army unit in Roosevelta street, had been adapted, in the 1990s, to house the Poviat Office for Employment (PUP) and the Municipal Office for Family Aid (MOPR). Both institutions were moved to new buildings. In 2010, parallel to the preliminary plan of adaptation of the buildings located at 40A Roosevelta street to the needs of the Faculty of Biomedical Engineering, a new concept was born - to build new laboratory facilities 'from scratch'. The initial design was developed by two authors: Grzegorz Nawrot and Tomasz Wagner[13] and completed in 2010. On its basis, in the years 2011/12, the GPVT Architectural Studio - GPVT Pracownia Architektoniczna S.C. Tomasz Białoszewski and Grzegorz Pacer developed a design for the construction and rebuilding of the PUP and MOPR building and converting it into a didactic building of the Faculty. On 23 February 2015, the new edifice of the Faculty of the Biomedical Engineering of the Silesian University of Technology was opened in Zabrze, at the following address: ul. Roosevelta 40A. The new building housed the dean's office, academic teachers' offices and didactic rooms. The building's basements (from the northern side) temporarily housed laboratory facilities. The southern part of the basement contained a cafeteria featuring an external terrace sunken below ground level.

Between 2013-2015, the authors of the concept[14] introduced many significant changes in the preliminary design of the laboratory wing. The architecture of the object was altered completely. Instead of the post-modernist wing of the same height as the didactic building, a new vision was born – of a cutting-edge edifice dominating the surroundings with its height, standard and unique character. Instead of using ceramic clinker, the elevations were designed as planes of composite panels and

[11] *Ibid.*, p. 6.
[12] *Ibid.*, p. 7.
[13] Installation diagrams by Krzysztof Kolonko, MSc, Eng.
[14] Grzegorz Nawrot, Tomasz Wagner; Department of Housing and Public Architecture Design RAr-2, Faculty of Architecture at the Silesian University of Technology (Katedra Projektowania Architektury Mieszkalnej i Użyteczności Publicznej RAr-2 Wydział Architektury Politechniki Śląskiej).

façade glazing of different degrees of transparency. Taking into consideration the changing legal regulations concerning car parks, instead of constructing an openwork ground floor for parking spaces, it was proposed to purchase plots adjacent to the university's premises from the southern side and to build a two- or three-storey car park without an approach ramp (as the site was an escarpment adjacent to W. Reymonta street). The total surface area of the laboratory facilities was estimated to be 2.359 m^2. Some rooms required the clear height of 4.5m. Significant differences in the required height of the rooms contributed to the heightening of the whole edifice. An auditorium, which was previously designed above the entrance hall and was supposed to constitute an element of the body of the entrance block was eventually separated from the body of the laboratory facilities and sunken below ground by one storey. Instead of being just an ancillary building, the new laboratory wing was given a new role to play. It became the formal and spatial dominant of the whole campus of the Silesian University of Technology in Zabrze.

1.2. Construction of the Assist Med Sport Silesia laboratories – the present EHTIC edifice in Zabrze

On 3 February 2016, a framework contract of collaboration was signed between the Faculty of Biomedical Engineering and the Philips company. In December 2017[15], in the city of Katowice, an agreement was signed between the Silesian University of Technology (Politechnika Śląska) and the Marshal Office of the Silesian Voivodeship (Urząd Marszałkowski Województwa Śląskiego). The Centre was founded within the framework of the project: *Assist Med Sport Silesia*, where the Silesian University of Technology, the city of Zabrze and the Dutch company renowned for being a leader in new technologies became official partners in the implementation of the project. The laboratory facilities were planned as *a complex of highly specialized laboratories, where new technologies and medical products were going to meet the challenges of contemporary medicine, particularly in the scope of ageing society and personalized medicine*[16].

In the period between 2017-18, on the basis of an upgraded preliminary design (authors: G. Nawrot, T. Wagner), a construction company selected by way of tender, namely BBC Best Building Consultants Limited Liability Company (sp. z o.o.) elaborated the design for the construction and completion of the whole investment. The architectural part was designed by Adam Niedośpiał, MSc, Eng., Arch., whereas the structure was designed by Adam Mańka, MSc, Eng. In December 2017, in Katowice, the contract regarding the investment was signed between the Silesian

[15] http://www.gloszabrza24.pl/wydarzenia/17732 [access: 15.12.2021].
[16] www.gloszabrza24.pl/wydarzenia/17752 [access: 15.12.2021].

University of Technology and the Marshal Office of the Silesian Voivodeship. The Centre of Engineering-Aided Medicine and Sport (Centrum Inżynierskiego Wspomagania Medycyny i Sportu) 'Assist Med Sport Silesia' in Zabrze. On the grounds of the signed contract, the Faculty of Biomedical Engineering gained a partner – the Philips company – the world leader in the field of medical technologies. The project was financed within the framework of the Regional Operational Programme (RPO) of the Silesian Voivodeship for the years 2014-2020, its total cost amounting to 92 million PLN. The signing of the foundation deed and breaking ground with a ceremonial shovel took place on 20 May 2020. In the phase of construction works, Professor Marek Gzik approved the final name of the laboratory facilities: European HealthTech Innovation Center - EHTIC (Europejskie Centrum Innowacyjnych Technologii dla Zdrowia). The construction of the edifice lasted from spring 2020 to September 2021. The building works were carried out by the Mostostal Zabrze Company, the Gliwice Industrial Construction Company (Mostostal Zabrze, Gliwickie Przedsiębiorstwo Budownictwa Przemysłowego - GBPB). Łukasz Leonhard was the site manager, whereas Ewa Steiman was the surveyor on behalf of the Silesian University of Technology. The official opening of the EHTIC Centre took place on 4 October 2021 within the European HealthTech Innovation Congress. The event was held under the patronage of the President of the Republic of Poland Andrzej Duda, who attended the ceremony in person. The object continued to be further furnished with laboratory equipment, furniture and information / marking system elements until 2022.

Fig. 1. Signing the foundation deed of the European HealthTech Innovation Centre by the Mayor of the City of Zabrze Małgorzata Mańka-Szulik, PhD; His Magnificence Vice-chancellor of the Silesian University of Technology, Professor Arkadiusz Mężyk; the Dean Elect Professor Zbigniew Paszenda and Dean Professor Marek Gzik, the Director of the EHTIC – on 20 May 2020.
Source: Photo from the archives of the Faculty of Biomedical Engineering of the Silesian University of Technology in Zabrze

Fig. 2. Official opening of the European HealthTech Innovation Centre by the President of the Republic of Poland Andrzej Duda – on 4 October 2021
Source: Photo from the archives of the Faculty of Biomedical Engineering of the Silesian University of Technology in Zabrze

Fig. 3. Panorama of the campus of the Silesian University of Technology in Zabrze from the entrance terrace of the Faculty of Biomedical Engineering. A view of the former assembly square of the army unit adapted as parking space. State as of September 2018
Source: Photo by Tomasz Wagner

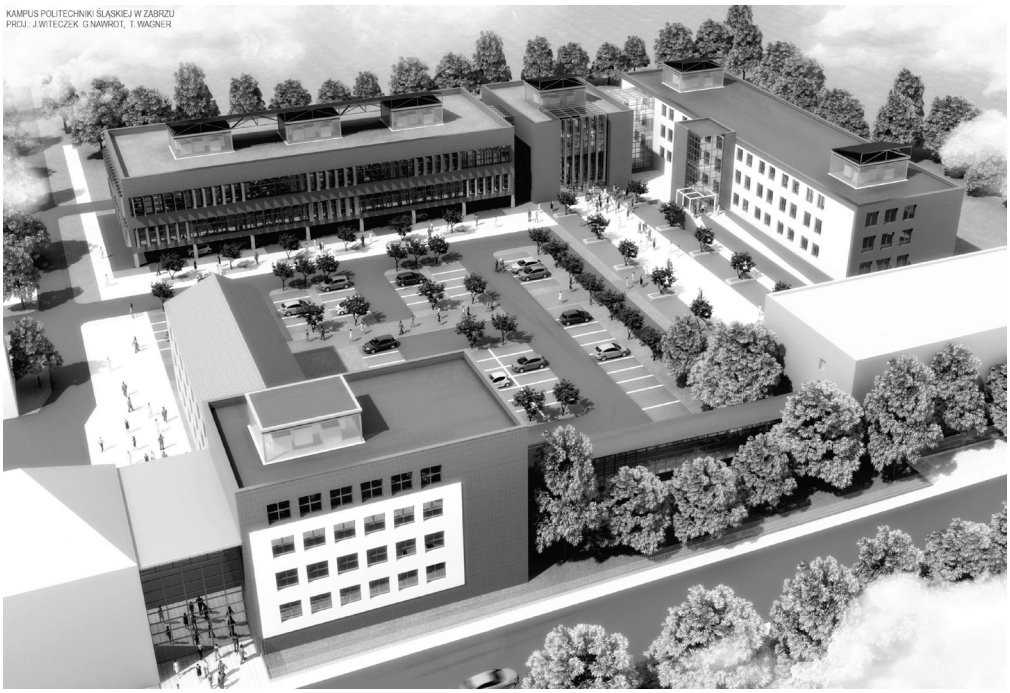
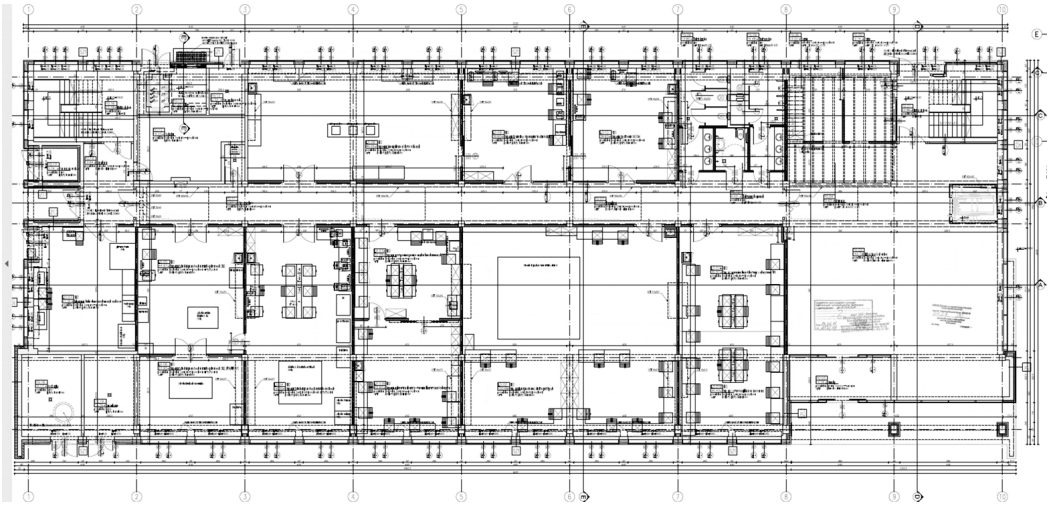


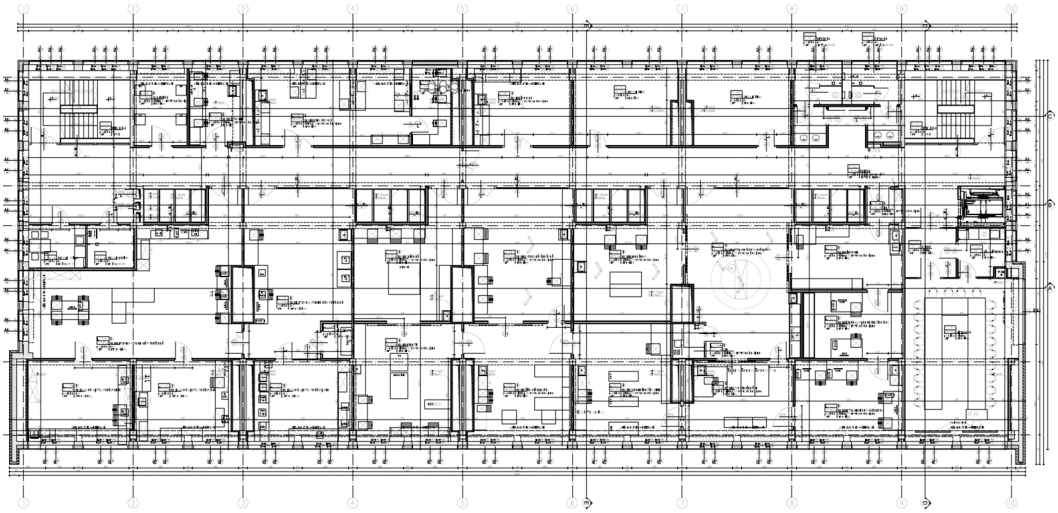
Fig. 4. Campus of the Silesian University of Technology in Zabrze – a bird's eye view from north east (from Roosevelta street), October 2010. Design by Jerzy Witeczek, Grzegorz Nawrot, Tomasz Wagner

Fig. 05. Visualization of the edifice of laboratory facilities of the Faculty of Biomedical Engineering, as of October 2010. A north-east vista. Design: Grzegorz Nawrot, Tomasz Wagner

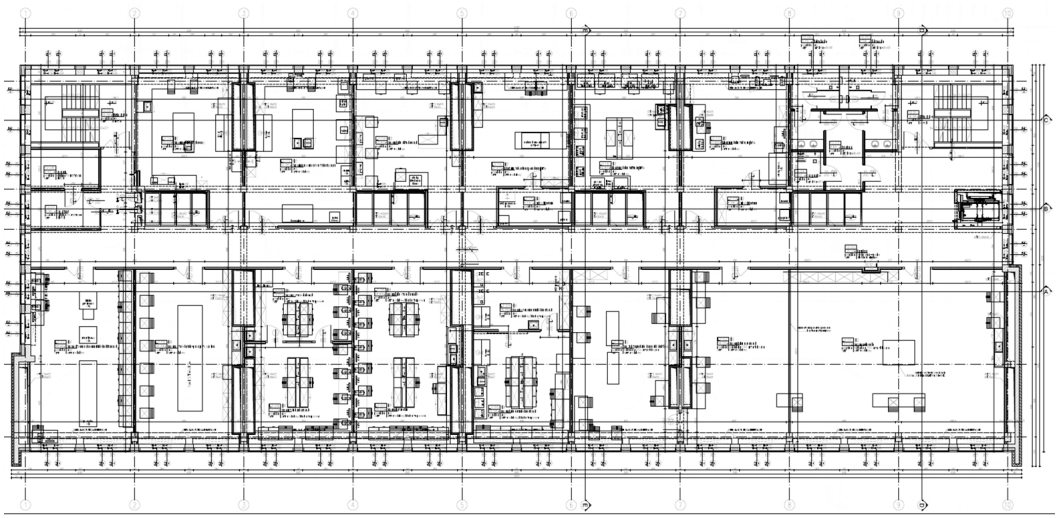
Fig. 06. Edifice of laboratory facilities of the Faculty of Biomedical Engineering – the final version of the design, ready for implementation, 2016. A north-east vista. Design: Grzegorz Nawrot, Tomasz Wagner



Ground Floor



1st Floor



2nd Floor

Fig. 7-9. European HealthTech Innovation Centre (EHTIC). Floor plans – a fragment of the building's construction design documentation - BBC Best Building Consultants sp. z o.o. (Ltd. co.), architect Adam Niedośpiał, on the basis of the preliminary design by G. Nawrot and T. Wagner, RAr-2

Fig. 10. Construction of the EHTIC edifice. The skeleton of the building - a view from north-west. State of works as of November 2020. Photo by T. Wagner

Fig. 11. Construction of the EHTIC edifice. The structure of the ground floor – a view from the space of the main hall. State of works as of December 2020. Photo by T. Wagner

Fig. 12. Construction of the EHTIC edifice. The Philips Auditorium after the installation of hollow-core slabs of the terrace roof. State of works as of the end of November 2020. Photo by T. Wagner

Fig. 13. Construction of the EHTIC edifice. The second floor, the hall of the human motor organ laboratory, after the installation of the truss ceiling. State of works as of January 2021. Photo by T. Wagner

Fig. 14. Construction of the EHTIC edifice. The second floor – roofing over the vast space of the northern belt of laboratories. State of works as of January 2021. Photo by T. Wagner

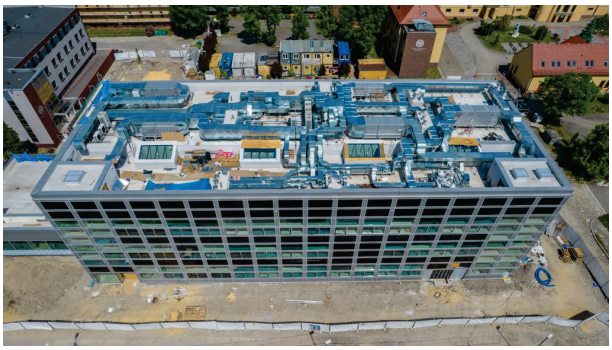


Fig. 15. EHTIC - a bird's eye view. The roof with photovoltaic panels, ventilation inlets/outlets and air conditioning being just installed at that time. State of works as of 1 July 2021 (archives of the construction process)

Fig. 16. EHTIC – a bird's eye view. South façade and the building of the Faculty of Biomedical Engineering (on the left side). State of works as of 1 July 2021 (archives of the construction process)

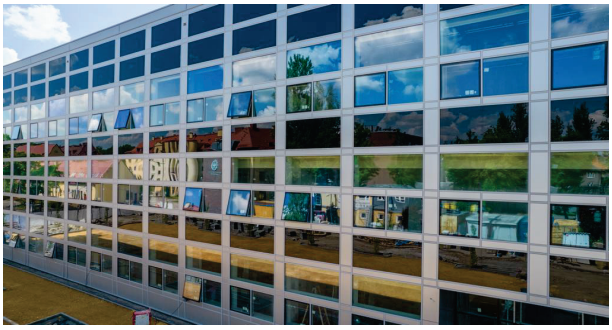


Fig. 17. EHTIC – a bird's eye view. North façade. State of works as of 1 July 2021 (archives of the construction process)

1.3. Functional and spatial structure of the EHTIC building in Zabrze

The EHTIC laboratory facilities building was designed by: Grzegorz Nawrot (preliminary design), Tomasz Wagner (preliminary design and interior design), Adam Niedośpiał (construction design and implementation project) and BBC Best Building Consultants. The EHTIC edifice was devised as a smart and energy efficient building having a compact structure (body) and the aesthetic resulting from its function. A uniform, cuboidal, three-storey body of the energy-efficient building is 58.5 m long, 23.5 m wide and 18 m high. The EHTIC edifice is linked to the building of the Faculty of Biomedical Engineering by means of a passageway (ramp-like passageway, with its technical storey located at level -1) and the body of the auditorium. They constitute a kind of neutral 'podium', which does not obscure or affect the perception of both buildings. On that elevation there is a didactic and recreational terrace, which is accessible from the corridor and from the conference and teletransmission hall located on the first floor of the EHTIC. The terrace is also accessible from the Faculty building. The EHTIC edifice has a total surface area of over 4.000m^2 and a cubature of approximately 22.000m^3.

The main entrance to the building was designed, from the north side, in the form of arcades, which are flush with the wall of the auditorium. The main circulation routes consist of two staircases, located at the opposite ends of the building, linked by means of an internal corridor, which is provided with additional lighting by a skylight and four glazed shafts. The glazed shafts let additional light into the building interior (the building is almost 25m wide). Thanks to the zones with transparent grid-like glass floor, the corridors were made wider and gained an additional leisure and recreational function. A modular system of laboratories (of different surface areas and various requirements concerning light access) became an inspiration for the creation of an alternating structure of the corridor. On the ground floor, the skylights are located along the corridor. On the 1st floor, the corridor gets

around the light shafts from the south side, whereas on the 2nd floor from the north. Thanks to that concept, it was possible to design laboratories of different width and lighting parameters. The flat roof features staircases' exits. It is the place where all technical devices are located, such as the central ventilation installation, air-conditioning units, etc. In order to neutralize a visual impact of these elements, architects designed a high attic, which in its highest part is 3.0m high, above the façade.

On the outside, the laboratory building is a monochromatic structure with a flat façade, flanked from the east and west by clinker gable walls. The elevation was made in the form of a raster consisting of composite panels in matt aluminium colour (designed as a system without bars). Windows in the façade were made as structural glazing without any bars. The glass used in the elevation was made in the form of a collage of planes having different degrees of transparency and reflectivity: 20, 35, 50, 70, 100%, including some areas with shutters (preventing dazzle). Different colour accents were introduced for each storey in order to denote a particular floor. This solution is just one of many elements which facilitate the building's accessibility for the people with disabilities, especially visual impairment. The following colours: yellow (ground floor), blue (1st floor) and red (2nd floor) facilitate orientation inside the building and accentuate the location of the building in the university campus in the city of Zabrze (yellow, blue and red are the colours of the flag and coat of arms of the city of Zabrze). In the phase of designing the interiors, many details, in particular those concerning accessibility, were specified more precisely. For instance, sanitary facilities were supplemented, the break room was enlarged, horizontal glazed surfaces (unfit for walking on) between the storeys were secured by means of a steel grid, a series of elements of land development were re-designed (e.g. rain drains of slots max. 2cm).

Fig. 18. EHTIC – a north-west vista, a view of the entrance square, September 2021. Photo by Grzegorz Wagner

Fig. 19. EHTIC – a north-east vista, from the courtyard of the Faculty of Organization and Management, September 2021. Photo by G. Wagner

Fig. 20. EHTIC – a south-east vista, road access and technical staff entrance, September 2021. Photo by G. Wagner

Fig. 21. EHTIC – the main entrance hall, September 2021. Photo by Grzegorz Wagner

Fig. 22. EHTIC – the main entrance hall, the wall with graphics, 150x720cm, featuring 294 important figures of the European science, mainly physicians, physicists, chemists and mathematicians contributing to the current state-of-the-art development of biomedical engineering. Photo by G. Wagner

Fig. 23. EHTIC – Philips Auditorium, September 2021. Photo by G. Wagner

Within the framework of the programme 'Dostępność Plus' (Accessibility Plus)[17], the EHTIC building was equipped with additional sanitary facilities on the first floor (toilet and shower for the people with physical disabilities) and on the second floor (initially, an accessible toilet was located only on the ground floor), a break room adapted to the needs of people with physical disabilities, security measures for the glazing, tactile guidance paving, colour contrasts and tactile maps. Recreational annexes (glazed shafts) were equipped with armchairs, chairs, hammocks and Brazilian hanging chairs, which gave the building the features of a creative space, and at the same time provided some leisure and interaction space (beyond the laboratories) to be used by employees who work long hours. The main functional units of the EHTIC building are as follows:

- entrance hall along with the reception desk and mezzanine as well as the Philips Auditorium;
- computer vision and virtual reality laboratory;
- rapid prototyping laboratory (LSP);
- laboratory of pre-operative planning of surgical procedures along with a seminar room;
- laboratory of implant structure testing (LBSI);
- laboratory of implant surface functionalization (LFPI);
- laboratory of engineering-aided stomatology (LIWS);
- laboratory for testing mechanical properties of medical products (LBWMWM);
- laboratory of biometrics and control-measurement systems;
- laboratory of computer-aided designing of biomechatronic devices;
- laboratory of biomorphic materials;
- laboratory of telemedical systems;
- front office and office rooms;
- staff room (office break room);
- server and IT supervision room.

An important element of the innovation is the accessibility of the building and its closest surroundings to people with disabilities. As far as the land development is concerned, the designers eliminated curbs to the maximum degree. The number of 'blue' parking spaces (size 4.0/4.5x6m, usually left free for the disabled) was reduced to three, however, new 'red' spaces were introduced for 'persons 60+' (an innovative idea implemented for the first time at the Silesian University of Technology), in

[17] Accessibility design developed in 2021 by autor prof. PS Tomasz Wagner, konsultanci: prof. PS. Katarzyna Ujma-Wąsowicz i dr Iwona Benek. Rozwiązania stanowiły próbę znalezienia standardu politechnicznego i rozwiązań eksperymentalnych.

addition, spaces for parents and children, pregnant women, etc. This system guarantees a more efficient use of 'special' parking spaces than the traditional 'X-marked' spaces. The land development also included the supplementation of circulation routes with additional lighting, benches and tables, an information pylon and the diversity of shrubbery along the circulation routes. The stairs located next to the cafeteria's sunken terrace were narrowed and equipped with a section fit for sitting. The whole vista was crowned with the concrete pylon displaying the date of the construction completion - 2021. Initially, the date was going to be written in Roman numerals: MMXXI, as a 'play' of repeated signs. However, the contractor decided to change it into Arabic numerals in order to broaden the circle of recipients (cit.).

2. ICONOGRAPHIC PROGRAMME OF THE EHTIC EDIFICE

Pożegnał się ten z rozumem,
Kto świat sławił świateł tłumem,
Kto ceni, lub mieni
Śmiecisko, świetlisko (...)
Nie nasyci świat pigułka,
Skruszy zęby twarda bułka.
Kamieni nie mieni
W bażanty, w alkanty.
Bied, plag, płaczów świat jest skrzynia,
Coraz chorób, szkód przyczynia
Zamczysta, nieczysta;
Na koniec - śmierć goniec![18]

He who said goodbye to his mind,
Who glorified the world blind,
Who appreciated or valued
Garbage dump, glittering tinsel charm (...)
A pill will not fill the world or bequeath
Hard bread will break your teeth.
Stones will not change, even if you pine,
Into pheasants, into Alicante wine.
World – the trunk of misery, plagues and wailing,
Causes us disease and ailing.
Sprawled, unclean;
Death-bellman will do it in!

Józef Baka (1707-1780)

[18] Baka Józef, *Notes on Death Inevitable Yet Common, expressed in a poem [...] provided with the introduction by Raymund Korsak, published in Vilnius in 1807, and now for the third time reprinted in 1828.,* Warsaw 1828 (*Uwagi o śmierci niechybnej wszystkim pospolitej, wierszem wyrażone [...] z przedmową Raymunda Korsaka w Wilnie 1807 roku wydane, a teraz po trzeci raz 1828 roku przedrukowane.,* Warszawa 1828.) Free translation into English by T. Wagner, M. Cesarz 2021.

2.1. Concept background and historical references

The above-cited fragment of the poem *'Notes on Death Inevitable Yet Common' ('Uwag o śmierci niechybnej wszystkim pospolitej')* by J. Baka is a motto of the iconographic programme of the EHTIC edifice – leading to an eclectic, postmodernist play of loosely-connected phrases taken out of the history of European culture of different epochs. The graphic programme, created by the author of this article in 2020/21, attempts to express the intellectual climate of the first phase of the COVID 19 pandemic, which apart from being the time of medical challenges was also the time of many significant events in the world of culture and the time of intellectual reflection. A particularly interesting aspect of the new pandemic was the comeback of mankind's archetypal associations connected with plague and death, the power of human mind (but also the impact of stupidity), the potential of science, especially medical sciences, and the power of community.

Large-format pictures, presented two years before, within the framework of the project 'Art on Campus' (the project implemented by the professors of the Silesian University of Technology Natalia Bąba and Tomasz Wagner) were met with remarkably positive reception both among students and academic teachers[19]. That was the reason why His Magnificence Vice-chancellor Arkadiusz Mężyk, Prof., PhD (DSc) Hab., Eng., decided to continue the project and grant the funding for the implementation of photo wallpapers in the interiors of the European HealthTech Innovation Center. The subject matter was connected with the history of medicine and its presentation in art masterpieces, including paintings and engravings, chiefly by Flemish masters, which was a way of showing appreciation to the Philips company for their contribution to the whole enterprise.

[19] Between 2019-20, within the framework of the project 'Art on Campus', large-format printouts/photo wallpapers were made to commemorate Wojciech Pszoniak (the building of the Faculty of Architecture, located at the following address: ul. Marcina Strzody 10, Gliwice), Zofia Rydet (the building of the Faculty of Architecture, address: ul. Akademicka 7, Gliwice), Zbigniew Religa (the building of the Faculty of Biomedical Engineering, address: F.D. Roosevelta 40a, Zabrze) and the placement of the cornerstone for the first building of the Silesian University of Technology (the building of the Faculty of Mining Engineering, Safety Engineering and Industrial Automation, address: ul. Akademicka 2, Gliwice). Moreover, recreational zones in Student Dormitories (e.g. Student Dormitory DS Barbara) were equipped with engravings and paintings made by the students and academic teachers of the Faculty of Architecture (WA Wn, WA) of the Silesian University of Technology.

Fig. 24. '*O śmierci niechybnej*' ('On Death Inevitable') – a computer graphic collage
The engraving depicts striding Death, which is seen only by viewers coming through the passage connecting the EHTIC edifice with the Faculty building (an anamorphic perspective conceals a skull, which is revealed at a certain angle – similar to the painting 'The Ambassadors' by Hans Holbein (1497-1543)). In the painting, Death is visible only to the deceased whose bodies were used in anatomic investigations. Small figures, immersed in books, are those who do not perceive the inevitability of death. They are characters from the engraving by the Netherlandish artist Pieter Bruegel the Younger depicting a Dutch proverb: *'A donkey will never become a horse, even if it goes to school'* (1556). Hovering 'balloons' are, in fact, dissected urinary bladders (symbolizing post-truth). On the left-hand side, there 'conceals' himself Erasmus of Rotterdam, the author of the treatise *Stultitiae Laus – In Praise of Folly* (1509). He juxtaposes folly, being the source of happiness, with wisdom, which leads to anguish and premature death
Location: Passage between the EHTIC edifice and the building of the Faculty of Biomedical Engineering; author T. Wagner 2021

The paintings were integrated with the interiors and bring a humanistic and timeless dimension to the building, indicating the significance of the human thought development which surpasses the technical aspects. The co-existence of art and science has been one of the most crucial stimuli to the development of creativity (for instance, creative office spaces). Art 'tames' the interior and makes it more humane. It creates favourable conditions for reflection and, at the same time, contributes to the growth of prestige of a given institution. The thematic programme of the EHTIC art can be divided into several groups. The first group includes 'quotations' from the Old Masters in the form of large-format wallpapers depicting masterpieces by Rembrandt, Hieronymus Bosch, Michelangelo Buonarroti and Pieter Breugel.

Some of the implemented graphic engravings (e.g. imprints on the protective foil on glazing) were classified within the framework of an accessibility programme making the building more available to people with disabilities, and were financed by the fund 'Dostępność Plus' ('Accessibility Plus'). The above-mentioned implementations included protective belts for large glass surfaces providing security to persons with visual impairment. The final version of the iconography, with slight changes, was approved by the EHTIC Director, Marek Gzik, Prof., PhD (DSc) Hab.,

Eng., Dean of the Faculty of Biomedical Engineering 2012-2020. The EHTIC iconography pays tribute to biomedical engineering being an interdisciplinary scientific field, which was born in the last few decades of the 20th century, but has turned out to be the next revolution in the development of medical sciences after the scientific breakthrough of the 15th/17th centuries.

Biomedical engineering – in accordance with the constantly generated and supplemented definition – *is a science combining the knowledge of technical, medical and biological disciplines (...) Its area of expertise translates technical knowledge into medical applications*[20]. Encyclopaedia Britannica describes it as: the application of engineering knowledge to the fields of medicine and biology. The bioengineer may work, depending on their specialization, in any of the areas where medicine and biology overlap. One of these, and the most important, is the provision of artificial means to assist defective body functions and impairment in the natural functioning of living organisms, especially human beings[21]. The following fundamental branches of the development of biomedical engineering can be distinguished:

- *Medical Engineering* – refers to the application of engineering principles to medical issues, including the replacement of damaged organs, health care systems and equipment, for instance the use of computers for diagnostic purposes;
- *Agricultural Engineering* – encompasses the application of engineering-aided methods to the issues of biological production;
- *Bionics* – the knowledge of living systems, which can be applied to designing physical systems;
- *Biochemical Engineering* – the application of engineering principles to microscopic biological systems which are used to make new products through synthesis, including the production of protein from proper raw materials;
- *Human Factors Engineering* – the use of engineering, physiology and psychology in the optimization of the human-machine relation;
- *Environmental Health Engineering*, also called *Bioenvironmental Engineering* – refers to the application of engineering principles to control the environment in order to improve human health, comfort and safety (including life support systems in space and ocean exploration);

[20] Definicja za: wikipedia.org/wiki/Inżynieria_biomedyczna, www.britannica.com/technology/bioengineering#ref66445 [dostęp: 15.12.2021].

[21] Na przykład wszelkiego rodzaju protetyka, sztuczne narządy, aparaty słuchowe, protetyka ortopedyczna oraz urządzenia umożliwiające zdalne działania medyczne czy też urządzenia podtrzymujące życie.

- *Genetic Engineering* – deals with the modification and recombination of the DNA or other particles of the nucleic acid in order to modify organisms[22].

The increasing significance of biomedical engineering and methodological revolution in the approach to the interdisciplinary overlapping of medical, biological and engineering sciences will revolutionize medicine in the nearest decades, similarly to the revolution occurring on the threshold of the Early Modern Period. Revolutions of a different scale and importance took place in various periods of history. However, the only comparable revolution to the one happening at the turn of the 20th and 21st centuries (and still continuing) is the revolution which occurred on the threshold of the Early Modern Period. Identical features of these two revolutions include: the alteration of universal communication means, transformations in terms of ethics and outlook on the world, development of empirical sciences in new areas of study, interdisciplinary approach of scientists and the overlapping of scientific fields.

At the beginning of the Early Modern Period, the majority of Galen's theories, dating back to Antiquity, were rejected and replaced with science based on empiria[23]. Before that, anatomical dissection of human bodies, being the crucial driving force behind the development of anatomy, had rarely been conducted[24]. That fact had not resulted from the 'ban' issued by the Church, as it is often interpreted, but from the culture, mentality and mores of the Middle Ages. At the beginning of the 14th c. Mondino de Luzzi - Mundinus (1270-1326)[25] and in the 15th c. Alessandro Achillini (1463-1512) and Antonio Benivieni (1443-1502), thanks to human body dissections, partly invalidated Galen's theories, which were chiefly based on dissections performed on animals. That period also witnessed the studies conducted by Leonardo da'Vinci (1452-1519). Contrary to the majority of cases where convicts' bodies were used for post-mortem, he obtained a consent to use the cadaver of an over 100-year-old man, a poorhouse dweller, to perform an autopsy on it, investigating, among other things, atherosclerosis[26]. It was only in 1540 that Vesalius (the professor of surgery and anatomy at the University of Padova) publically debunked Galen's theory of anatomy.

[22] Gałęzie rozwoju inżynierii biomedycznej podane za:
www.britannica.com/technology/bioengineering# ref66445 [dostęp: 15.12.2021].

[23] *Lindemann, Mary, Medicine and Society in Early Modern Europe (Medycyna i społeczeństwo we wczesnej nowożytnej Europie). Cambridge University Press, 2010, p. 92.*

[24] Up to the beginning of the 16th c., the anatomical knowledge of human organism was obtained mainly by analogy with animal organisms.

[25] britannica.com/biography/Mondino-de-Luzzi [access: 15.12.2021].

[26] Isaacson Walter, Leonardo da Vinci, Warsaw (Warszawa) 2019.

Fig. 25. Statue of St. Bartholomew Flayed - depicting skinned Bartholomew the Apostle, 1562, by Marco d'Agrate (1504-1574), transept of the Duomo Cathedral in Milan, Italy. The inscription engraved by the sculptor on the statute pedestal: *Non mi fece Prassitele, bensì Marco d'Agrate*, ('I was not made by Praxiteles, but by Marco d'Agrate') is an expression of not only hubris, but, in fact a declaration of breaking off with classical tradition in favour of mannerist naturalism. The statute (called the first 'anatomical sculpture') is an example of the use of a religious theme to show the achievements of the 16th-century anatomy. Photo by T. Wagner, 2021

Fig. 26. Cabinet of Curiosities (Kunstkamera), a 'Trompe-l'oeil' type of painting by Domenico Remps (1620–1699), an Italian painter, probably of Flemish or German origin. In the EHTIC building, the reproduction of the painting is displayed on the wall of the staff room located in the east part of the corridor, on the 1st floor. Illustration source: Museo dell'Opificio delle Pietre Dure, Florence (public domain)

An essential factor that stimulated and contributed to the development of scientific research in the 16th century was the invention of a printing press and printing method by Johannes Gutenberg in Europe between 1440 and 1453[27] (however, also Laurens Janszoon Coster (1370-1440) a townsman from Haarlem in

[27] In China, the movable type was already known several hundred years earlier; the date of 1453 is symbolic, as before the printing of the famous Gutenberg Bible, Gutenberg probably used this new method to print Latin textbooks *Ars minor* by Aelius Donatus (the so-called Donatus's works) starting from the year 1440.

Holland was a purported inventor)[28]. The above-mentioned invention enabled a cheap and fast production of books, increased greatly their accessibility and speeded the transfer of knowledge. The development of communication methods in different historical periods had an impact on the economy and social life. An American theoretician of communication, Herbert Marshall McLuhan[29] (1911-1980) stated that *a character of a communication means has a greater impact on the recipient that the transmitted information itself.* Other essential factors contributing to the development of societies included: the popularization of a newspaper – information periodical in the second half of the 18th century, the invention of a telephone exchange (telephone switch) in the last decade of the 19th century, or the development of the Internet at the end of the 20th century. Each time, the means of transmission entailed transformations in mentality, awareness, perception of the world (also understood as the development of science) and caused revolutionary social changes...

A new phenomenon which appeared in the Early Modern Period was the Cabinet of Curiosities, the so-called Kunstkamera. They were massively popular with the aristocracy who created the prototypes of the present-day museums in their stately homes. The aristocracy collected outstanding masterpieces, precious items, trophies, collections of natural science exhibits from all over the-then known world – the-then universum[30], but also curiosities and objects of a small value but having a great power of impression and influence. Following the centuries of basing human convictions on structured and encyclopaedic knowledge, once again the humanity is coming back to the randomness of the informational chaos. The contemporary global version of Kunstkamera is the Internet. In a similar way to the old Kunstkamera, the Internet gathers information which is partly structured and is based not only on knowledge, but also on convictions and intentions[31], with the focus on curiosum and stupidity.

[28] *Ernst Kelchner: Coster, eigentlich Laurens Janssoen. In: Allgemeine Deutsche Biographie. T. 4. Leipzing: 1877, p. 515* (this publication writes about Antwerp as the place of the first publication).
[29] McLuhan Herbert Marshall *Galaktyka Gutenberga. Tworzenie człowieka druku* Narodowe Centrum Kultury 2017 (orig. *The Gutenberg Galaxy: The Making of Typographic Man* 1962).
[30] www.enzyklopaedie.ch/Kunstkammern/Kunstkammern_Liste.html [access: 02.02.2020].
[31] Globalna Kunstkamera i pragnienie tożsamości w zderzeniu z trendami współczesnej architektury.

Fig. 27. University of Padova – the 'ancient' courtyard in Palazzo del Bo, where, the oldest in Europe, anatomical theatre is located. Photo by Tomasz Wagner 2021

Fig. 28. Anatomical theatre – in Italian: *Teatro anatomico di Padova* (1594) designed by Fabricius. Photo by Marco Bisello 2006 (public domain)

Nicolò Ceccarelli writes: *The voyage that humankind began in the 16th Century towards scientific knowledge is most fascinating. Interestingly, the quest for knowledge to 'modernity' followed with equal intensity two apparently opposite directions. As the 'discovery' of the New World opened the way to the season of exploration of unknown far-away places, a parallel journey started taking place towards one other uncharted territory: the human body*[32].

Human body as a *microcosmos* became, in the 16th and 17th centuries, a subject of exploration and investigation, which were made possible by the development of anatomy and technology, the liberation of knowledge from the limitations imposed by religion as well as the accessibility and swiftness of knowledge transfer by means of the invention of printing. A parallel, not literal but metaphorical one, can be drawn between that period and the transformations occurring in the contemporary world. For instance, doing scientific research and experiments using streaming methods, new materials and means of information processing as well as changes in the sphere of bio-ethics – are all after-images of trends and phases which have already taken place many times throughout history.

[32] Ceccarelli, Nicolò, (Università degli Studi di Sassari), *Things are (not) always what they seem. Animating scientific visualization: the case of anatomy,* Project: informative animation in: JOUR - IP Inform. Animation - 2013. research, education and design experiences, PY - 2017/10/28, www.researchgate.net/publication /320685941 [dostęp: 15.12.2021].

2.2. The content presented

Hieronymus Fabricius (Girolamo Fabrizio d'Acquapendente) (1537-1619) was one of the most renowned Italian physicians, surgeons and anatomy specialists of his time. One of his most important inventions was tracheotomy[33]. One of Fabricius' achievements in the field of architecture serving the purpose of medicine was the construction of an anatomical theatre at the University of Padova, in Pallazo del Bo, in 1594. The structure and concept was used in medical clinics up to the 20th century as the main method of presentation of surgical procedures and post-mortem. The cadavers were transported through an underground canal directly onto the operational table. In the EHTIC building, the transmission of the image between the room of surgical procedure simulations and the tele-transmission room takes place by means of an optical fibre connection. Nowadays, there is no longer need of direct participation (presence) in a dissection procedure or scientific experiment. The figure of Hieronymus Fabricius is evoked by his print, which is presented in the analyses room adjacent to the tele-transmission room. Fabricius' drawing, from around 1600, depicts *Oplomoclion.* It is a kind of orthopaedic corset – exoskeleton for the treatment of patients with bone fractures, or the ones requiring correction of deformations of the spine and limbs, or patients with different degrees of disabilities.

A significant figure, the traces of whom can be found inside the EHTIC building, is Robert Fludd (1574-1637) – an English aristocrat, physician, pharmacist, astrologer and occultist. His important achievement was the development of Paracelsus' theory stating that the sources of illnesses are located outside the human organism (the-then medicine focused on the ancient theories of 'bad blood' and the upsetting of balance between elements / fluids in a human organism). Fludd developed also the theory of blood circulation in the organism[34].

In the room of surgical procedure simulations, in the EHTIC edifice (room no 103), there is a chart (visio I) *Catoptrum Microcosmicum* by Johann Remmelin (1583-1632), a German physician, philosopher, cabalist and mathematician, living between 1583-1632. *Catoptrum Microcosmicum* (Latin: A Mirror of the Microcosmos – a review of the microcosmos being the anatomy of male and female bodies) is an anatomy textbook in the form of anatomical flap works. It was the first printing attempt to present a human organism in a three-dimensional form. The above-mentioned room of surgical procedure simulations is linked by teletransmission means with the conference / teletransmission room, which is decorated with a 4.5-metre-wide

[33] Wolfgang U. Eckart Christoph Gradmann (red.): *Lekarze Leksykon: od starożytności do chwili obecnej* (Ärzte Lexikon: Von der Antike bis zur Gegenwart). Wydanie III. Springer Medizin Verlag, Heidelberg 2006.

[34] Debus, Allen G, *Robert Fludd i krążenie krwi* , J Hist Med Allied Sci (1961) XVI (4): 374-393. doi: 10.1093/ jhmas/XVI.4.374.

reproduction of the fresco *The Creation of Adam* by Michelangelo Buonarroti, completed in 1511. This most-known fragment of the Sistine Chapel, popularized in mass culture, is a reference to the role a human being / a physician plays in medical sciences. This issue was presented in an excellent way in the film *Bogowie (Eng. 'Gods'), 2014,* based on a true story about Professor Zbigniew Religa, a cardiac surgeon, and his medical team. The heart transplantation conducted by Professor Religa took place in the city of Zabrze, in the Silesian Centre for Heart Disease (Śląskie Centrum Chorób Serca w Zabrzu), in 1985. This achievement was commemorated in the hall of the adjacent building of the Faculty of Biomedical Engineering within the framework of the project *Art on Campus* in 2020.

Fig. 29. Surgical procedure simulation room, EHTIC, 1st floor, room no 103. In the background: *Catoptrum Microcosmicum* by Johann Remmelin, 1619
Source: Photo by G. Wagner 2021

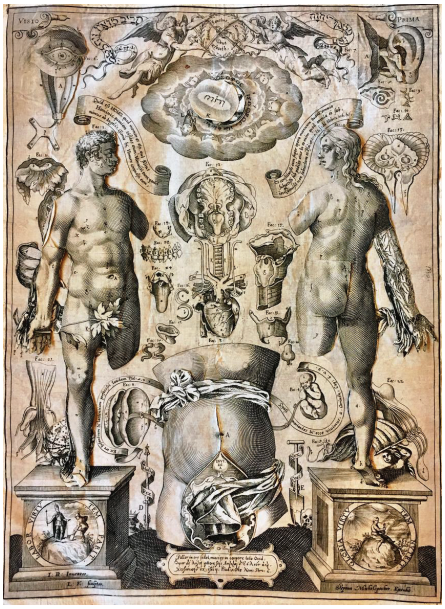


Fig. 30. Page from *Catoptrum Microcosmicum* (Lat. Mirror of Microcosmos). A fragment of the anatomical flap book by Johann Remmelin, 1619

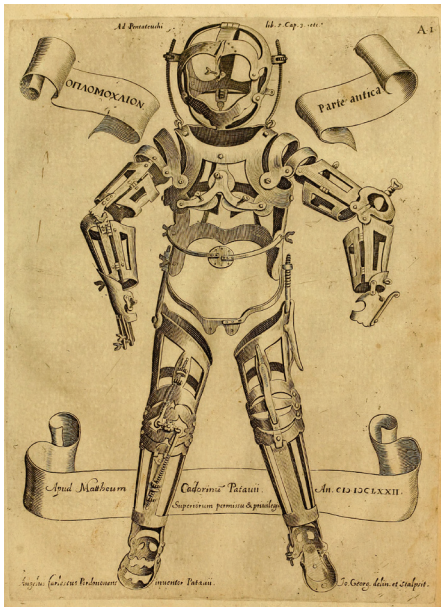


Fig. 31. *Oplomoclion* (1600), a draft of an exoskeleton by Hieronymus Fabricius. Location: EHTIC, 1st floor, room no. 102A. Illustration
Source: *Operationes chirurgicae*, Padova, 1672

Fig. 32. *The Extraction of the Stone of Madness* (The Cure of Folly) (created between 1494 and 1515) by Hieronymus Bosch (around 1450 – 1516). The original painting's dimensions 34.5x47.5 have been enlarged ten times here, which makes it possible to thoroughly observe the details of the painting. Location: EHTIC, 2nd floor, corridor. Source: Photo by Grzegorz Wagner, 2021

Fig. 33. *The Physician* (Doctor Studying a Bottle) (1653) by Gerard Dou (1613-1675) (Gerrit Douw), the original of dimensions 49.3 x37 cm is exhibited in the Museum of Art History in Vienna (public domain)

The corridors on the EHTIC storeys were equipped by the designers also with other paintings. For instance, in the recreational zone near the lift there is a small fragment (50x50cm) of the painting *The Physician (or Doctor Studying a Bottle)* by Gerard Dou (1613-1675). Gerard Dou (known also as Gerrit Douw) was Rembrandt's student. His paintings are exhibited at the Rijksmuseum in Amsterdam, Museum Boijmans Van Beuningen in Rotterdam, Mauritshuis in the Hague and Museum de Lakenhal in Leiden. The artist began his career in a workshop making stained-glass windows and that might have been the reason why his portraits were often painted in the window frame, which was organically integrated with the external frame of the picture. In the EHTIC building, only a fragment of the painting was placed between the frames of contemporary internal windows. A specific jest or play with the Flemish painting does not end here. Dou *was obsessed with order and cleanliness. In a maniacal way he tried to keep his workshop tidy, so only a very small number of people was allowed to visit it. He kept his brushes and painting tools spotlessly clean*[35]. That is why the fragment of his painting with a doctor closely observing a glass bottle with urine has been placed on the wall adjacent to the toilets. The building (in its east part) features six more fragments of the paintings of that period depicting pharmacists, physicians and alchemists. The decision to place them there was purely pragmatic and resulted from the fact that they needed to mask inspection chambers with information technology cables.

The corridors located on subsequent floors feature, much enlarged in relation to the originals, the following paintings: '*The Peasant Wedding'* by Pieter Breugel, '*The Music Lesson'* by Johannes Vermeer and '*The Extraction of the Stone of Madness'* by Hieronymus Bosch. The works by these remarkable Flemish painters are related here with the subject laboratories located on particular storeys. For instance, 'The Music Lesson' is in a close vicinity of the laboratory dedicated to acoustic measurements. 'The Peasant Wedding' is located near the laboratories dedicated to prosthodontics (initially, the painting was to be placed near the laboratory of motion testing). The head office room on the 1st floor features '*The Anatomy Lesson of Dr Nicoales Tulp'* (1632) by Rembrandt Harmenszoon van Rijn (1606-1669). The painting does not show a real anatomy lesson, but commemorates the participants of an anatomical spectacle, i.e. the members of the guild of surgeons from Amsterdam[36]. Apart from the presented physicians, the masterpiece features also two less obvious participants. The first one is Adriaan Adriaanszoon, the deceased man who was

[35] Zuffi Stefano, *Rembrandt,* Warszawa: HPS, 2006, p. 27.

[36] The date of the event could have been 31 January 1632: The Amsterdam Guild of Surgeons, where Tulp was an official municipal anatomist, allowed only one public anatomical dissection a year, whereas the body had to belong to an executed criminal, quotation after: Rachlin Harvey, *Scandals, Vandals and Da Vincis: A Gallery of Remarkable Art Tales,* New York, Penguin Books, 2007, pp. 55-61.

sentenced to death by hanging for stealing a coat. The other one is the author of the anatomy textbook. The book depicted in the right-hand bottom corner is *De Humani Corporis Fabrica* by the already mentioned Andreas Vesalius[37].

The main entrance hall of the EHTIC edifice is decorated with a graphic piece of dimensions 150 x720cm, which presents 294 renowned figures in European science, mostly physicians of different specializations, physicists, chemists, mathematicians and philosophers, who contributed to the development or had an impact on the present-day capabilities of Biomedical Engineering. Some of them, like: Jan Wandelaar (1692-1759), Bernardino Genga (1620–1690), Ambroise Paré (1510–1590) are authors of the figures used in collages, which are located in other EHTIC rooms.

Fig. 34. Astrologer (astronomer), pharmacists and alchemist – figures connected with the sciences related to medicine in the Middle Ages and on the threshold of the Modern Period. Photo by T. Wagner

Fig. 35. *The Wedding Dance* (full name: *The Wedding Dance in the Open Air*), 1566, by Pieter Bruegel the Elder (1525-69), original of the dimensions 119.4 × 157.5 cm Location: EHTIC, ground floor, corridor. Source: Photo by Grzegorz Wagner, 2021

[37]Lyons Albert S. Petrucelli Joseph R., *Medicine: An Illustrated History*, New York 1987, p. 426.

Fig. 36. *The Music Lesson*, around 1660, by Johannes Vermeer (1632-75), the virginals feature the inscription:
MUSICA LETITIAE CO[ME]S/ MEDICINA DOLOR[IS]
(Music is a companion to joy and a medicine for pains).
Location: EHTIC, 1st floor, corridor
Source: Photo by Grzegorz Wagner, 2021

The EHTIC building features several large-format engravings, which were made using a method of digital graphic collage by the author of this article. Some of them refer to the 'Trompe-l'oeil'[38] imaging method, which was used in *Kunstkamera* by Domenico Remps. These are engravings enclosed in printed frames, where the depicted figures often go out of these frames. Initially, three of the graphics (*Motion I-III*) were supposed to be placed in the motion testing laboratory on the 2nd floor. Another one, *On Death Inevitable* (Fig. 24.) was located in the passage joining the EHTIC with the Faculty building. *Sapientia dentium* found its place in the prosthodontics laboratory, whereas *The Blind* on the ground floor (CAD laboratory). Other engravings made for the EHTIC building were used in the form of overprint on semi-transparent frosted films, which were required in order to reduce transparency of glazing in the circulation routes (in compliance with the requirements of the accessibility programme 'Dostępność Plus').

The glass walls of the laboratories, which are adjacent to the recreational zones on the 1st and 2nd floor, were supposed to be provided (at the users' request) with films to completely obscure the view of the laboratory. Finally, all of them were provided with Latin inscriptions on medicine or wisdom (science, knowledge) [39]. The 1st floor features the following ones:

[38] *Trompe-l'oeil* (in French: deceiving the eye) – a contemporary name of the phenomenon of a three-dimensional 'perception' of a flat surface, or of a puzzling moment of uncertainty and reflection. Precursors of the contemporary trompe l'oeil appeared in the Renaissance period when a mathematically correct perspective was discovered. Source of the definition: Web Gallery of Art, link: https/www.wga.hu/frames-e.html?/html/r/remps/cabinet.html [access: 2021.12.21].

[39] *Soma's Dictionary of Latin Quotations, Maxims and Phrases,* Victoria, Trafford Publishing, Canada, 2010.

1. *"OMNIUM ARTIUM MEDICINA NOBILISSIMA EST" (Lat. Medicine is the noblest of all arts),* author: Hippocrates of Kos*,* (around 460 BC - 375 BC);
2. *PER SCIENTIAM AD SALUTEM AEGROTI (Lat. To heal the sick through knowledge);*
3. "OPTIMUM MEDICAMENTUM QUIES EST" (Lat. Peace is the best medicine), author: Celsus (53 BC, died around 7 AD);
4."HOMINIS EST ERRARE, INSIPIENTIS IN ERRORE PERSEVERARE" (Lat. To err is human, but to persevere in error is only the act of a fool), author: Cicero (106 BC – 43 BC)

and on the 2nd floor:
1. "SAPIENTIA ARS VIVENDI PUTANDA EST" (Lat. Wisdom is the art of living), author: Plaut; (around 250 BC - 184 BC)
2. "HOMO DOCTUS IN SE SEMPER DIVITIAS HABET" (Lat. A learned person always has riches within), author: Phaedrus (around 15 BC – 50 BC);
3. "ADHIBE RATIONEM DIFFICULTATIBUS" (Lat. Bring the mind to bear upon your problems / or Adhere to reason when in trouble), author: Seneca the Younger (4 BC – 65 AD).

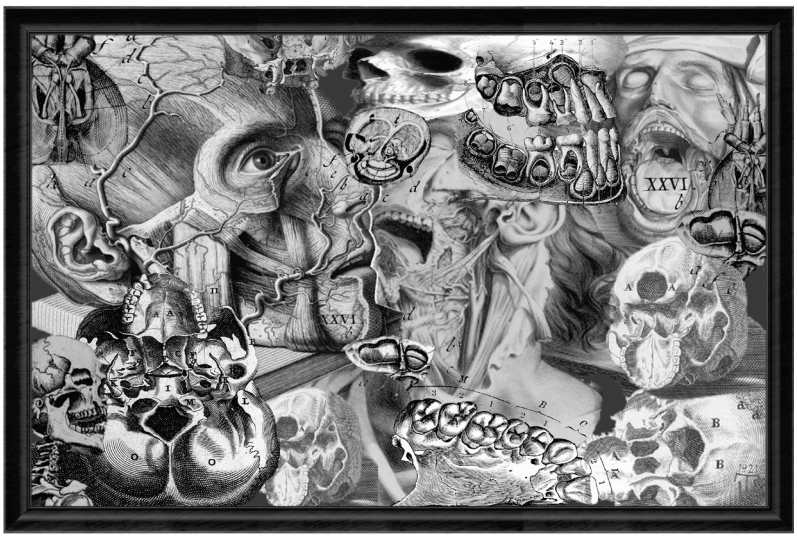


Fig. 37. Digital engraving / graphic collage: *Sapientia dentium,* (EHTIC, 1st floor, prosthodontics laboratory), room 108

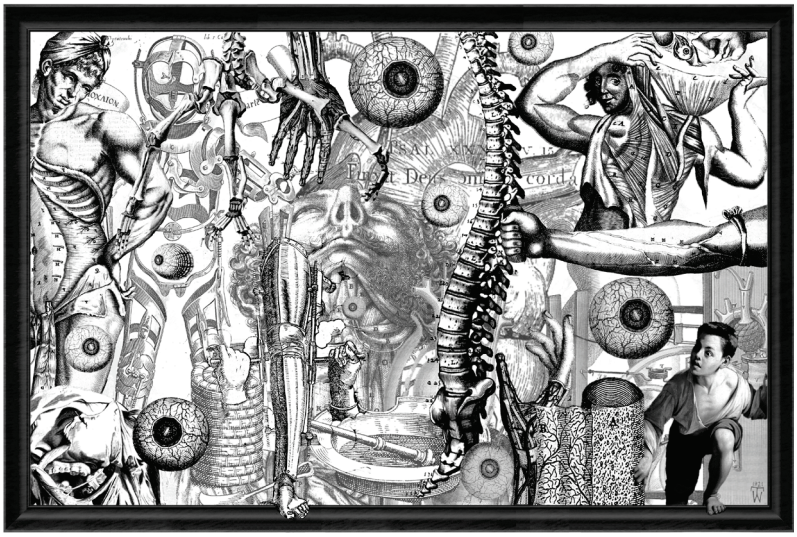


Fig. 38.
Digital engraving / graphic collage: *The Blind* (EHTIC, ground floor, CAD laboratory), room 110. In the central part of the engraving there is a fragment of Psalm 33 (verse 15): Finxit Deus omnia corda (Lat. He who forms the hearts of all). In the right-hand bottom corner of the engraving, a boy is coming out of the picture beyond the frame. He is a figure from one of the most popular paintings of "Trompe l'oeil" kind in the art history, entitled: *Escaping Criticism* by Pere Borrell del Caso

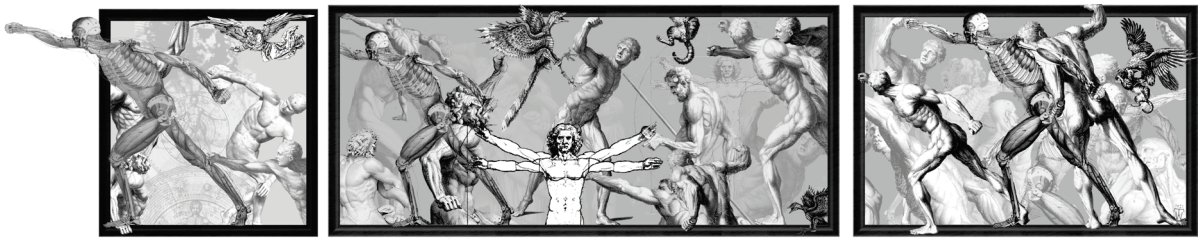


Fig. 39. Sequence of 3 engravings, entitled: Motion I, Motion II, Motion III, designed for the biometrical testing laboratory, room no 201, location: EHTIC, ground floor and 2nd floor

Fig. 40. EHTIC –an engraving on the protective film on glass walls, placed at a height from 1.45 to 1.70 m, providing protection for the persons with visual impairment, implemented within the framework of the accessibility programme 'Dostępność Plus'
Source: Photo by G. Wagner

Fig. 41. EHTIC – Latin dicta in recreational zones located in glazed shafts providing additional light to the circulation routes and internal rooms. In the picture: a recreational annex between rooms 102 and 103 on the first floor
Source: Photo by G. Wagner

Fig. 42. EHTIC – Glazed shafts providing additional light to the circulation routes and internal rooms. In the picture: a recreational annexe between rooms 102 and 103,on the first floor, seen from the ground floor
Source: Photo by G. Wagner

Fig. 43. EHTIC – *The Creation of Adam* (1511). A fragment of the frescos from the ceiling of the Sistine Chapel by Michelangelo Buonarroti (1475-1564), (public domain), location: EHTIC, 1st floor, teletransmission room no. 101 A. The photograph taken during the process of wallpapering in September 2021
Source: Photo by T. Wagner

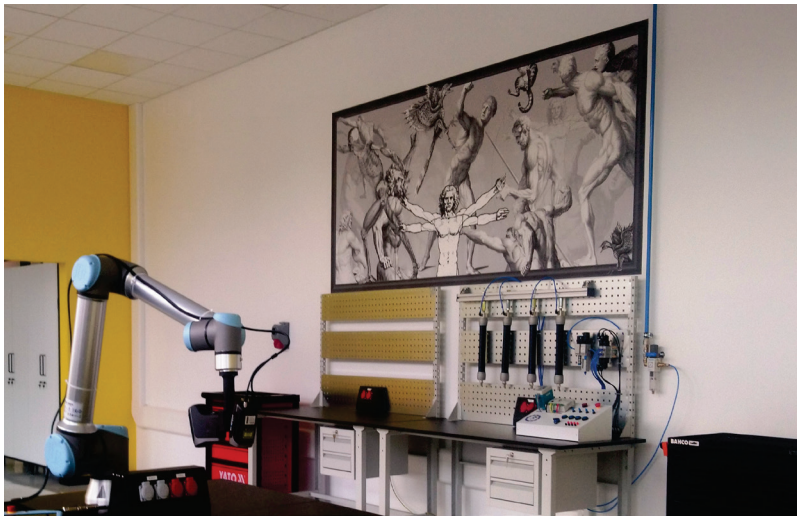


Fig. 44. EHTIC – Engraving 'Motion II', room no. 008
Source: Photo by T. Wagner

Fig. 45. Director of EHTIC – Professor Marek Gzik, in the background: *The Anatomy Lesson of Dr Nicoales Tulp* (1632) by Rembrandt Harmenszoon van Rijn (1606-1669)
Source: Photo by G. Wagner

3. SUMMARY

The European HealthTech Innovation Center (EHTIC) was built in stages, beginning from the first design assumptions of the laboratory facilities at the Faculty of Biomedical Engineering, through the project AssistMed Silesia, to the actual construction between 2020-21. The construction took place in a difficult period of the COVID-19 pandemic caused by virus SARS-CoV-2, the beginning of which, in Poland, dates back to 4 March 2020, when the first case of infection was confirmed. The pandemic - comparable to other global epidemics of previous epochs - made us aware of the fact that we are part of the history of human fight for health and well-being. We realized that we are immersed in the space and culture encompassing the whole development of medicine and related sciences from Antiquity to the present time. The pictures integrated with the rooms and halls of the EHTIC building contrast

with modern architecture and create a post-modernist collage of artistic motifs and historical content. The narrative inside the EHTIC edifice induces the viewer to pause, reflect and redefine their thinking on the subject of 'a human being embedded in time'.

Acknowledgements:

On behalf of the whole team participating in the implementation of the European HealthTech Innovation Center, I would like to express sincere gratitude to His Magnificence Vice-chancellor of the Silesian University of Technology Professor Doctor Habilitated Engineer Arkadiusz Mężyk for subsidizing the project Art on Campus in the EHTIC building and to the Director of the EHTIC Professor Doctor Habilitated Engineer Marek Gzik for placing his trust in us and giving us a unique chance of implementing timeless and humanist iconographic content in the EHTIC edifice.

REFERENCES

1. Baka J.: Uwagi o śmierci niechybnej wszystkim pospolitej, wierszem wyrażone [...] z przedmową Raymunda Korsaka w Wilnie 1807 roku wydane, a teraz po trzeci raz 1828 roku przedrukowane., Warszawa 1828.
2. Ceccarelli N.: Things are (not) always what they seem. Animating scientific visualization: the case of anatomy, Università degli Studi di Sassari PY – 2017/10/28 Project: informative animation: www.researchgate.net/publication/320685941
3. Childress D.: Johannes Gutenberg and the printing press.: Twenty-First Century Books, Minneapolis 2008.
4. Debus Allen G.: Robert Fludd i krążenie krwi , J Hist Med Allied Sci (1961) XVI (4): 374-393. doi: 10.1093/ jhmas/XVI.4.374.
5. Eckart W. U., Gradmann Ch. (edit.): Lekarze Leksykon: od starożytności do chwili obecnej (Ärzte Lexikon: Von der Antike bis zur Gegenwart). Wydanie III. Springer Medizin Verlag, Heidelberg 2006.
6. Isaacson W.: Leonardo da Vinci, Warszawa 2019.
7. Kelchner E. C.: in: Allgemeine Deutsche Biographie. T. 4. Leipzing: 1877.
8. Lindemann M.: Medycyna i społeczeństwo we wczesnej nowożytnej Europie. Prasa uniwersytecka, Cambridge 2010.
9. Lyons A. S., Petrucelli J. R.: Medicine: An Illustrated History, New York 1987.
10. Marciniak J., Paszenda Z.: Historia Wydziału Inżynierii Biomedycznej Politechniki Śląskiej, Zabrze, 2020, a digital document: www.polsl.pl/rib/wp-content/uploads/sites/84/2020/12/Historia-Wydzialu-IB.pdf [access: 15.12.2021].
11. Mcluhan H.M.: Galaktyka Gutenberga. Tworzenie człowieka druku, Narodowe Centrum Kultury, Warszawa 2017 (orig. The Gutenberg Galaxy: The Making of Typographic Man, 1962).

12. Rachlin H.: Scandals, Vandals and Da Vincis: A Gallery of Remarkable Art Tales, New York, Penguin Books, 2007.
13. Soma's Dictionary of Latin Quotations, Maxims and Phrases, Victoria, Trafford Publishing, Canada 2010.
14. Śląska Inżynieria Biomedyczna, wydawnictwo konferencji naukowej, Politechnika Śląska, Zabrze 2012.
15. Zuffi S.: Rembrandt, HPS, Warszawa 2006.
16. www.britannica.com/biography/Mondino-de-Luzzi [access: 15.12.2021].
17. www.britannica.com/technology/bioengineering# ref66445 [access: 15.12.2021].
18. www.enzyklopaedie.ch/Kunstkammern/Kunstkammern_Liste.html [access: 02.02.2020].
19. www.gloszabrza24.pl/wydarzenia/17752 [access: 15.12.2021].
20. www.gloszabrza24.pl/wydarzenia/17732 [access: 15.12.2021].
21. www.wikipedia.org/wiki/Inżynieria_biomedyczna [access: 15.12.2021]
22. www.wga.hu/framese.html?/html/r/remps/cabinet.html Web Galery of Art, [access: 2021.12.21].
23. Documentation of the project: Europejskie Centrum Innowacyjnych Technologii dla Zdrowia - European HealthTech Innovation Center (EHTIC) Rzuty kondygnacji – dokumentacja projektu budowlanego – BBC Best Building Consultants sp. z o.o. arch. Adam Niedośpiał, na podst. projektu wstępnego G. Nawrota i T. Wagnera, RAr-2.

SPIS ILUSTRACJI

Beata KUCHARCZYK-BRUS, Agata WYCIŚLOK

ANALIZA DANYCH STATYSTYCZNYCH DOTYCZĄCYCH BUDOWNICTWA W KONTEKŚCIE PRZETWARZANIA ODPADÓW BUDOWLANYCH I MOŻLIWOŚCI ICH WTÓRNEGO WYKORZYSTANIA W ARCHITEKTURZE

Ada KOŁODZIEJCZYK-KĘSOŃ

STANDARDY BUDYNKÓW PASYWNYCH – PORÓWNANIE ARCHITEKTONICZNE

Aleksandra ŚLIWA

KOMPILACYJNA PRZESTRZEŃ MIESZKALNA W POSTPANDEMICZNYM SMART CITY. POTENCJAŁ ADAPTACJI MIESZKAŃ W ZABUDOWIE WIELORODZINNEJ KATOWIC

Ivona DLÁBIKOVÁ, Martina PEŘINKOVÁ, Jan KOVÁŘ

DEVELOPMENT OF GRAVES AND BURIAL RITUALS IN EUROPE BEFORE THE GREAT ROMAN EMPIRE

Rys. 1. Dolmeny w Mané-Karioned należą do grupy dolmenów Carnac i datowane są na około 3500 lat p.n.e., dwa dolmeny zostały otwarte na południe, a trzeci, centralny dolmen, usytuowany jest pod kątem prostym do pozostałych.
Źródło: rysunek Iwony Dlábikovej

Rys. 2. Rysunek po lewej stronie pokazuje plany pięter Dolmenów w Mané-Karioned, dwa dolmeny zostały otwarte na południe, a trzeci, centralny dolmen, usytuowany jest pod kątem prostym do pozostałych. Rysunek po prawej stronie przedstawia uproszczony obraz linii wygrawerowanych na kamieniach przy wejściu i na korytarzu. Ich znaczenie pozostaje niewyjaśnione, ale prawdopodobnie reprezentuje labirynt lub węża.
Źródło: rysunek Iwony Dlábikovej

Rys. 3. Plan piętra i fragment grobowca Atreus tholos.
Źródło: rysunek Iwony Dlábikovej

Rys. 4. Wazon grobowy zwany kraterem był naczyniem do oznaczania grobu mężczyzny, z kolei amfora dla kobiety. Katafalk otoczony jest rodziną, przyjaciółmi i zawodowymi żałobnikami, którzy siedzą lub klękają z rękami uniesionymi nad głowami w geście żalu.
Źródło: Rysunek Iwony Dlábikovej, według fragmentu krateru, archaiczna sztuka grecka 700-600 r. p.n.e., Luwr

Rys. 5. Celtowie byli mistrzami symboliki i symbolicznych znaków. Abstrakcję można zobaczyć w tej monecie i jej realistycznej wersji obok, przedstawiającej ten sam motyw dwugłowego węża, reprezentującego życie i śmierć, oraz dwóch kóz, symbolizujących płodność.
Źródło: Rysunek Iwony Dlábikovej, rysunek i komentarz zaczerpnięty z [13]

Tomasz WAGNER

POWSTANIE I REALIZACJA GMACHU EHTIC NA TERENIE KAMPUSU PŚ W ZABRZU. PROGRAM IKONOGRAFICZNY WNĘTRZA OBIEKTU (2020/21) JAKO PRZYKŁAD SYMBOLICZNEGO KOLAŻU DOBY PANDEMICZNEJ.

Rys. 1. Podpisanie aktu erekcyjnego Europejskiego Centrum Innowacyjnych Technologii dla Zdrowia przez prezydent Miasta Zabrze dr Małgorzatę Mańkę-Szulik, JM Rektora PŚ prof. Arkadiusza Mężyka, dziekana elekta prof. Zbigniewa Paszendę i Dziekana prof. Marka Gzika, dyrektora EHTIC. 20 maja 2020. Fot. archiwum Wydziału Inżynierii Biomedycznej PŚ w Zabrzu

Rys. 2. Oficjalne otwarcie Europejskiego Centrum Innowacyjnych Technologii dla Zdrowia przez prezydenta RP Andrzeja Dudę, 4 października 2021. Fot. archiwum Wydziału Inżynierii Biomedycznej PŚ w Zabrzu

Rys. 22. EHTIC – główny hol wejściowy z grafiką o wymiarach 150x720 cm, na której przedstawiono 294 postacie nauki europejskiej, w większości lekarzy, fizyków, chemików i matematyków mających wpływ na obecne możliwości rozwojowe inżynierii biomedycznej. Fot. G. Wagner

Rys. 23. EHTIC – Audytorium Philips, wrzesień 2021. Fot. G. Wagner

Rys. 24. *O śmierci niechybnej* – grafika komputerowa – kolaż.
Obraz przedstawia kroczącą śmierć widzianą jedynie przez przechodnia idącego łącznikiem (silny skrót perspektywiczny ujawnia widzowi czaszkę (podobnie jak na obrazie "Ambasadorowie" Hansa Holbeina (1497-1543)). Widzą ją na obrazie jedynie zmarli wykorzystani do badań anatomicznych. Małe postaci zanurzone w czytaniu ksiąg to osoby niedostrzegające niechybności śmierci. Są to bohaterowie grafiki niderlandzkiego artysty Petera Bruegel'a Młodszego, która obrazuje holenderskie przysłowie: *Osioł nigdy nie stanie się koniem, nawet jeśli pójdzie do szkoły* (1556). Unoszące się baloniki to wydobyte w sekcji pęcherze moczowe (symbolizujące postprawdę). Po lewej stronie w tle chowa się Erazm z Rotterdamu, autor traktatu *Stultitiae Laus – Pochwała Głupoty* (1509). Zestawia on głupotę, jako źródło szczęścia, z mądrością, która doprowadza do cierpienia i przedwczesnej śmierci.
Lokalizacja: łącznik między budynkiem Wydziału Inżynierii, autor T. Wagner 2021.

Rys. 25. Rzeźba odartego ze skóry św. Bartłomieja Apostoła wykonana przez Marco d'Agrate (1504-1574), rok 1562, transept Katedry Duomo w Mediolanie – Włochy. Sentencja wykuta u podstawy figury przez autora: *Non mi fece Prassitele, bensì Marco d'Agrate* (Nie stworzył mnie Praksyteles, ale Marco d'Agrate) jest nie tylko aktem pychy, ale w gruncie rzeczy deklaracją zerwania z tradycją klasyczną na rzecz manierystycznego naturalizmu. Rzeźba (nazywana pierwszą „rzeźbą anatomiczną") to przykład wykorzystania tematu religijnego by ukazać osiągnięcia szesnastowiecznej anatomii. Fot. T. Wagner, 2021

Rys. 26. Gabinet osobliwości (Kunstkamera), obraz o charakterze "Trompe-l'oeil" autorstwa malarza włoskiego, prawdopodobnie pochodzenia niderlandzkiego (lub niemieckiego) Domenica Rempsa (1620–1699).
W EHTIC został zlokalizowany na ścianie pomieszczenia socjalnego, znajdującego się we wschodniej części korytarza 1 piętra. Źródło ilustracji: Museo dell'Opificio delle Pietre Dure, Florencja (domena publiczna)

Rys. 27. Uniwersytet w Padwie – dziedziniec antyczny Palazzo del Bo, gdzie znajduje się najstarszy w Europie teatr anatomiczny. Fot. Tomasz Wagner, 2021

Rys. 28. Teatr anatomiczny – wł. *Teatro anatomico di Padova* (1594) wg projektu Fabriciusa. Fot. Marco Bisello, 2006 (domena publiczna)

Rys. 29. Sala symulacji operacyjnych, EHTIC, 1. piętro, pom. nr 103. W tle *Catoptrum Microcosmicum* Johanna Remmelina z 1619 roku. Fot. G. Wagner, 2021

ANALYSIS OF STATISTICAL DATA ON CONSTRUCTION IN THE CONTEXT OF CONSTRUCTION WASTE PROCESSING AND THE POSSIBILITY OF THEIR REUSE IN ARCHITECTURE

Abstract

The world is dominated by the linear economy model, in which the amount of raw materials increases, and the product becomes waste at the end of its life. However, increasingly steps are taken to introduce a circular economy in which products are not wasted but reused.

Eurostat data show that over 35% of waste generated in the European Union is construction waste, which makes it a sector in which circular solutions especially are worth looking for. In order to get to know the data on construction in Poland, the focus was put on the analysis of statistical data from three sources - the Central Statistical Office (GUS), the Central Office of Construction Supervision (GUNB) and Voivodship Reports on waste management. The first one provides information on indicators in housing construction, construction and assembly production as well as the delivery of apartments and buildings in Poland. On the other hand, among the statistics obtained from the GUNB, it was possible to analyze data on the construction process and current trends in construction, i.e., building permits or demolitions carried out.

This paper shows that activities in the field of construction translate directly into material production, and this in turn into the production of construction and demolition waste. Each building permit represents a new construction site that will generate construction waste, and each construction and demolition is a potential source of materials.

In the statistics of the Central Statistical Office of Poland, data and correlations of data on the quantity, processing or storage of collected construction waste are difficult to trace both due to their enormous diversity and the relatively short period of reliable, selective waste collection in Poland. The analysis of statistical data allows to notice, inter alia, the increase in construction activity in recent years which necessitates the development of waste reduction strategies and better management of these residues. The combination of this information with the data contained in voivodship reports, on the basis of which the structure of construction waste was created, may allow in the future to build a set of guidelines for more intensive use of these materials.

Among construction waste from demolition and renovation, only a small fraction of the material is reused, such as concrete aggregate, steel or demolition brick. However, there are many examples where demolition materials can be reused, only if they are properly dismantled, deposited, and restored or recycled with little energy expenditure. The authors of the paper will present a few selected examples of successful Polish and foreign projects.

The aim of the paper is therefore to analyze statistical data related to the construction process and the related construction materials issues, as well as to present examples of re-use of building elements in construction. The methods that were used to conduct research in this area are: analysis of statistical data and data from reports of institutions related to the construction process, literature research, and own experience from the design work carried out.

ANALIZA DANYCH STATYSTYCZNYCH DOTYCZĄCYCH BUDOWNICTWA W KONTEKŚCIE PRZETWARZANIA ODPADÓW BUDOWLANYCH I MOŻLIWOŚCI ICH WTÓRNEGO WYKORZYSTANIA W ARCHITEKTURZE

Streszczenie

Na świecie dominuje model gospodarki liniowej, w której powiększa się ilość zużytych surowców, a materiał pod koniec swojego życia staje się odpadem. Coraz częściej jednak podejmuje się działania zmierzające do wprowadzenia gospodarki cyrkularnej, w której materiały nie są marnotrawione, lecz wykorzystywane ponownie.

Dane Eurostatu pokazują, że ponad 35% odpadów generowanych w Unii Europejskiej stanowią odpady budowlane, co sprawia, że jest to sektor, w którym szczególnie warto szukać rozwiązań cyrkularnych. W celu poznania danych dotyczących budownictwa w Polsce skupiono się na analizie danych statystycznych z trzech źródeł, Głównego Urzędu Statystycznego, Głównego Urzędu Nadzoru Budowlanego oraz wojewódzkich raportów dotyczących gospodarki odpadami. Pierwsze z nich dostarcza informacji na temat wskaźników w budownictwie mieszkaniowym, produkcji budowlano-montażowej czy mieszkań i budynków w Polsce. Z kolei w statystykach pozyskanych z GUNB możliwe było przeanalizowanie danych dotyczących procesu budowlanego i aktualnych trendów w budownictwie, a więc pozwoleń na budowę czy przeprowadzonych rozbiórek.

Niniejszy artykuł pokazuje, że działania w zakresie budownictwa przekładają się bezpośrednio na produkcję materiałową, a to z kolei na produkcję odpadów budowlanych i rozbiórkowych. Każde pozwolenie na budowę reprezentuje nowy plac budowy, który będzie generował odpady budowlane, a każda budowa i rozbiórka to potencjalne źródła surowców.

W statystykach GUS dane i korelacje danych na temat ilości, przetwarzania czy przechowywania zebranych odpadów budowlanych są trudne do prześledzenia zarówno z uwagi na ich ogromne zróżnicowanie, jak i stosunkowo krótki okres rzetelnej, selektywnej zbiórki odpadów w Polsce. Analiza danych statystycznych pozwala natomiast zauważyć m.in. wzrost aktywności budowlanej w ostatnich latach, który wpływa na konieczność opracowania strategii ograniczania odpadów i lepszego gospodarowania tymi pozostałościami. Połączenie tych informacji z danymi zawartymi w raportach wojewódzkich, na podstawie których utworzona została struktura odpadów budowlanych, może umożliwić w przyszłości zbudowanie zestawu wskazówek do intensywniejszego wykorzystywania tych materiałów.

Wśród odpadów budowlanych pochodzących z rozbiórek i remontów jedynie niewielki ułamek materiału zostaje ponownie wykorzystany, jak kruszywo betonowe, stal czy cegła rozbiórkowa. Jest jednak wiele przykładów pokazujących, że materiały rozbiórkowe mogą zostać użyte ponownie, przy założeniu że zostaną odpowiednio zdemontowane, zdeponowane i poddane renowacji lub przetworzeniu przy niewielkim nakładzie energii. Autorki artykułu dokonają prezentacji kilku wybranych przykładów udanych realizacji polskich i zagranicznych.

Celem artykułu jest zatem analiza danych statystycznych związanych z procesem budowlanym i powiązaną z nim sferą materiałową, a także prezentacja przykładów wtórnego wykorzystania materiałów w budownictwie. Metody, które zostały zastosowane do przeprowadzenia badań w zakresie tej problematyki, to: analizy danych statystycznych oraz danych z raportów instytucji związanych z procesem budowlanym, badania literaturowe, doświadczenia własne ze zrealizowanych prac projektowych.

THE PASSIVE BUILDING STANDARDS – ARCHITECTURAL COMPARISON

Abstract

One of the XXI century crises is air pollution and extreme weather changes. Building sector emits nearly 40% of total CO_2 and consumes one-third of global, final energy.

This article presents the architectural comparison and evaluation of Passive House, be2226 and Earth House standards. Those standards use architectural procedures to design passive, energy efficient buildings without the need of high technology to manage inside climate comfort. All presented buildings have low heating and cooling energy demand.

STANDARDY BUDYNKÓW PASYWNYCH – PORÓWNANIE ARCHITEKTONICZNE

Streszczenie

Jednymi z kryzysów XXI wieku są zanieczyszczenie powietrza oraz ekstremalne zmiany pogodowe. Sektor budowlany emituje prawie 40% całkowitej ilości CO_2 i zużywa jedną trzecią globalnej energii końcowej.

W artykule przedstawiono porównanie i ocenę architektoniczną standardów: Passive House, be2226 Earth House. Standardy te wykorzystują procedury architektoniczne do projektowania pasywnych, energooszczędnych budynków bez konieczności stosowania zaawansowanych technologii do zarządzania komfortem klimatu wewnętrznego. Wszystkie prezentowane budynki mają niskie zapotrzebowanie na energię do ogrzewania i chłodzenia.

COMPILATION DWELLING SPACE IN POSTPANDEMIC SMART CITY. THE POTENTIAL OF ADAPTATION OF APARTMENTS IN MULTI-FAMILY BUILDINGS IN KATOWICE

Abstract

The living space has become a multidimensional platform for activities taking place in real and virtual realities. The compilation house functions simultaneously in space and in the information cloud. The pandemic has emphasized the need for outdoor living spaces that are in contact with nature - the post-pandemic smart city dwelling is therefore intended to combine elements of culture, nature, and information.
The research includes analyses of the potential adaptation of exemplary dwellings to the needs of a smart city understood as a system combining built, natural and virtual worlds.

KOMPILACYJNA PRZESTRZEŃ MIESZKALNA W POSTPANDEMICZNYM SMART CITY. POTENCJAŁ ADAPTACJI MIESZKAŃ W ZABUDOWIE WIELORODZINNEJ KATOWIC

Streszczenie

Przestrzeń zamieszkiwania stała się wielowymiarową platformą dla aktywności odbywających się w realnej i wirtualnej rzeczywistości. Dom kompilacyjny funkcjonuje symultanicznie w przestrzeni oraz chmurze informacyjnej. Pandemia wzmocniła potrzebę zewnętrznych przestrzeni zamieszkiwania – postpandemiczne mieszkanie ma łączyć w sobie elementy kultury, natury oraz informacji.
Badania obejmują analizy potencjału adaptacji przykładowych mieszkań do potrzeb postpandemicznego Smart City rozumianego jako system łączący światy zbudowany, naturalny oraz wirtualny.

DEVELOPMENT OF GRAVES AND BURIAL RITUALS IN EUROPE BEFORE THE GREAT ROMAN EMPIRE

Abstract

Burials were always connected to belief of people in certain time. This work describes the oldest societies in Europe until the time of influence of Great Roman Empire. Many cultures connect the burial practices with kind of journey from one place to another, passage from one state to different one, what is declared by architecture and objects found in graves. The oldest graves imitate cave with a corridor and chamber inside.

ROZWÓJ POCHÓWKÓW I RYTUAŁÓW POGRZEBOWYCH W EUROPIE SPRZED CZASU WIELKIEGO CESARSTWA RZYMSKIEGO

Streszczenie

Rytuały pogrzebowe były zawsze związane z wierzeniami ludzi w danym okresie. Artykuł opisuje kształtowanie budowli związanych z pochówkami najstarszych społeczeństw w Europie do czasów wpływów Wielkiego Cesarstwa Rzymskiego. Wiele kultur łączyło praktyki pogrzebowe z pewnego rodzaju podróżą z jednego miejsca do

drugiego, przejściem z jednego stanu do innego, co ilustrują architektura związana z pochówkami oraz przedmioty znalezione w grobach. Układ najstarszych grobów stanowi imitację jaskini z korytarzem i komorą wewnątrz.

ESTABLISHMENT AND IMPLEMENTATION OF THE EHTIC EDIFICE AT THE CAMPUS OF THE SILESIAN UNIVERSITY OF TECHNOLOGY IN ZABRZE. ICONOGRAPHIC PROGRAMME OF THE BUILDING INTERIOR (2020/21) AS AN EXAMPLE OF A SYMBOLIC PANDEMIC-ERA COLLAGE

Abstract

The design of the EHTIC building by Grzegorz Nawrot and Tomasz Wagner (Faculty of Architecture of SUT Gliwice) and Adam Niedośpiał (BBC Best Building Consultants) was designed as an intelligent and energy-saving building with a compact structure and aesthetics resulting from the function. The construction of the building lasted from spring 2020 to September 2021. The construction works were carried out by Mostostal Zabrze, Gliwickie Przedsiębiorstwo Budownictwa Przemysłowego (GBPB). It is currently a university-wide unit of the Silesian University of Technology that conducts interdisciplinary research, service, information, training and promotion activities in the field of technology for health. The functioning of the facility is related to the development in the area of health technology, creation, development and implementation of innovative medical technologies, prevention, diagnostics and medicine. It is a group of highly specialized laboratories in which modern technologies and products are developed to respond to the challenges of modern medicine, especially in the area of an aging society, as well as personalized medicine and biomedical engineering.

The EHTIC iconographic program is an eclectic, postmodern game of loose phrases taken from the history of European culture. It is an attempt to express the intellectual climate of the first stage of the COVID 19 epidemic, which was, apart from the medical aspect, a time of a number of important events in the world of culture and a time of intellectual reflection. An interesting aspect of the time of the new pandemic was the return to the archetypal "dreams of humanity" about the power of death, destiny, human thought (but also stupidity), the period of returning faith in the power of science, especially medical science, and the power of community. The images integrated with the interiors are to give the building a humanistic, timeless and supra-technical dimension, symbolizing the development of human thought. The images integrated with the implemented interiors contrast with modern architecture, creating a postmodern collage of artistic content and historical motifs. This narrative, in conjunction with the EHTIC building, is a collage that encourages the viewer to stop, reflect and reevaluate thinking about setting "man in time".

POWSTANIE I REALIZACJA GMACHU EHTIC NA TERENIE KAMPUSU PŚ W ZABRZU. PROGRAM IKONOGRAFICZNY WNĘTRZA OBIEKTU (2020/21) JAKO PRZYKŁAD SYMBOLICZNEGO KOLAŻU DOBY PANDEMICZNEJ

Streszczenie

Budynek EHTIC, autorstwa Grzegorza Nawrota i Tomasza Wagnera (Wydział Architektury Politechniki Śląskiej, Gliwice) oraz Adama Niedośpiała (BBC Best Building Consultants), został zaprojektowany jako obiekt inteligentny i energooszczędny o zwartej bryle i estetyce wynikającej z funkcji. Budowa trwała od wiosny 2020 roku do września 2021 roku. Prace budowlane przeprowadziły Mostostal Zabrze oraz Gliwickie Przedsiębiorstwo Budownictwa Przemysłowego (GPBP). Jest to obecnie ogólnouczelniana jednostka Politechniki Śląskiej, prowadząca interdyscyplinarne działania badawcze, usługowe, informacyjne, szkoleniowe i promocyjne w zakresie technologii dla zdrowia. Funkcjonowanie placówki związane jest z rozwojem w obszarze technologii medycznych, tworzeniem, rozwojem i wdrażaniem innowacyjnych technologii medycznych, profilaktyką, diagnostyką i medycyną. Jest to zespół wysokospecjalistycznych laboratoriów, w których powstają nowoczesne technologie i produkty, które odpowiadają na wyzwania współczesnej medycyny, zwłaszcza w obszarze starzejącego się społeczeństwa, a także medycyny spersonalizowanej i inżynierii biomedycznej.

Program ikonograficzny EHTIC to eklektyczna, postmodernistyczna gra luźnych fraz zaczerpniętych z historii kultury europejskiej. Jest to próba oddania klimatu intelektualnego pierwszego etapu epidemii COVID 19, który poza aspektem medycznym był czasem wielu ważnych wydarzeń w świecie kultury i czasem refleksji intelektualnej. Ciekawym aspektem czasów współczesnej pandemii był powrót do archetypicznych snów ludzkości o potędze śmierci, przeznaczenia, ludzkiego rozumu (ale też głupoty), okres powrotu wiary w potęgę nauki, zwłaszcza medycznej i siły wspólnotowości. Dzieła mistrzów wkomponowane we wnętrza miały nadać budynkowi humanistyczny, ponadczasowy i ponadtechniczny wymiar, symbolizując rozwój myśli ludzkiej. Wkomponowane w zrealizowane wnętrza obrazy kontrastują z nowoczesną architekturą, tworząc postmodernistyczny kolaż treści artystycznych I motywów historycznych. Ta narracja, w połączeniu z budynkiem EHTIC, jest kolażem, który zachęca widza do zatrzymania się, zastanowienia I przewartościowania myślenia o znaczeniu „człowieka w czasie”.

WYDAWNICTWO POLITECHNIKI ŚLĄSKIEJ
ul. Akademicka 5, 44-100 Gliwice
tel. (32) 237-13-81, faks (32) 237-15-02
www.wydawnictwopolitechniki.pl

UIW 48600

Sprzedaż i Marketing
tel. (32) 237-18-48
wydawnictwo_mark@polsl.pl

Sprawy wydawnicze
tel. (32) 237-13-81
wydawnictwo@polsl.pl

Ark. wyd. 9

e-wydanie

Monografia 936

ISBN 978-83-7880-844-2
Monografia 940

Wydawnictwo Politechniki Śląskiej
44-100 Gliwice, ul. Akademicka 5
tel.(32) 237-13-81, faks (32) 237-15-02
www.wydawnictwopolitechniki.pl
Dział Sprzedaży i Reklamy
tel.(32) 237-18-48
e-mail: wydawnictwo_mark@polsl.pl