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Multi-use of small performance halls – case studies of modern cultural facilities in Poland

Abstract

Contemporary architecture is expected to meet not only functional goals and high aesthetic quality, but also to take into account changing social needs, which is in line with the trend towards sustainable building. It is therefore important to consider the idea of multifunctionality when implementing new developments, especially in small towns. The subject of this paper is the analysis of three buildings in Wieliczka, Dąbrowa and Pszczyna, in which the aspect of multifunctionality was considered differently. At the same time, the discussed examples will benefit researchers, investors and designers alike, as they present specific architectural aesthetic and technological solutions related to the realization of small auditoriums – a subject that is rarely dealt with in scientific publications. The main aim of this paper was to draw attention to the need for an individual approach to the design process and a multi-criteria search for optimal design solutions for the hall, moving away from standardization. Finally, the realization of small multifunctional performance space fits in with the idea of sustainable development, which is based on combining the needs of the present generation with the ability to meet the needs of future generations.

Key words: performance hall, sustainability, multi-functional buildings, multi-purpose buildings

Introduction

One of the simplest descriptions of modern times is its mutability and the dynamic functioning of society, which is completely different from the end of 20th century. At the end of the 1980s, Zygmunt Bauman introduced a vivid characterization of society as a consumerist one. Bauman strongly emphasized the omnipresent praise of transience and disdain for permanence. He noted that the short lifespan of products was profitable for the system, as it directly led to their faster replacement with new ones and thus increased market turnover and strengthened consumption [1]. Nowadays, the material durability of a given building is understood in a different way. It is seen as susceptibility for reconstructing form, function and often the structure itself. That way, architecture fits in the existence of modern

– consumer society in which the life cycle and processes of reproduction happen more quickly. The quicker we exploit certain objects, the quicker architecture should offer possible changes. The idea of building for the sake of durability is a debatable matter and multi-use seems like a perfect solution. In a period in which both technological evolution and changes in the functioning of societies are visible, the expectation that an object can serve in the long term and be able to adapt to the needs of the recipient is very important. The fact that many buildings seem unnecessary is starting to become apparent in cities. New needs appear which were not there before and they cannot always function in an existing building. In this field, it is desirable to apply the idea of multi-use [2].

Multifunctionality is particularly important in public architecture, which should be responsive and adaptable to changing social needs. The aim of this paper is to present contemporary cultural facilities with multifunctional spaces, highlighting the variety of possibilities for implementing technological and architectural solutions. The case study of Polish buildings in Wieliczka, Dąbrowa, Pszczyna specifically addresses the location and investment needs in

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relation to medium-size cities, where one building is likely to fulfil multiple purposes. The article identifies examples of spatial and aesthetic solutions, as well as technological, electrotechnical and, finally, acoustic solutions, which are closest to understanding the different approaches to the use of the performance hall.

Performance halls in the need of multi-use

It can be argued that the future of the performance halls lies in extending their usability with multi-use, as one of the basic issues in contemporary architectural design. In modern cities, there have been many cultural venues, as well as several independent ones for concerts and other events. These were usually large buildings with very specific parameters based on the main purpose, i.e., the organization of a conference meetings, theatrical performances or cinema screenings. Nowadays, we notice a greater emphasis on universal and at the same time varied use, which is due to both economic and practical factors – allowing their efficiency. Multi-use is thus becoming one of the principles of the current needs of cities, especially small and medium-sized ones in which cultural facility is also the only place where residents can participate in various types of shows.

The authors of this paper introduce separate definitions of multi-use of performance halls design, as multi-functionality and multi-purpose. Multi-purpose is the ability to use a room for specific functions by adapting it through appropriate design. Whereas in multi-functionality, design solutions aim to achieve a high degree of flexibility. Therefore, the approach to the design strategy must be different, taking into account economic factors and the potential for introducing variable acoustics.

The notion of multi-use of performance halls is currently discussed in the broad context of sustainable development, both in the study of the landscape and the city and understood as creating a project that could undergo modifications in the future [3]. Sarah Taylor Lovell and John R. Taylor compared the concept of the sustainable development with that of the multi-functionality. The sustainability is represented by the overlapping of environmental, economic and social pillars, whereas multi-functionality is envisioned as the stacking of ecological, production and cultural functions to achieve greater overall performance. In this perspective, the concept of multi-functionality means a space that allows different forms of use at different times. This approach differs from the concept of multi-purpose, which denotes spaces designed for different activities, denoting the functional flexibility of a space. The design of multi-functional performance halls requires a new approach that includes both a focus on economic performance and the specificity of social needs [4].

The most challenging part of multi-use halls is the concept of making them optimal and suitable for every audience while keeping the expenses at the level that is profitable for the investor. Executing a good performance design requires the right strategy to operate in many fields. In terms of architecture, the project requires a flexible approach and creative solutions, allowing changes in layout, for instance moving walls, folding audience stands, moveable cladding

and other specific elements. Preparing the stage in a smaller hall always needs a specific approach with regard to the limited area, while in larger spaces the solutions seem mostly universal. A very important matter is the attention to details and consideration of lighting, speakers, reflectors – elements that are potentially mobile. Various types of potential functions are also connected to a different approach to acoustics. Creation of modified acoustics is possible thanks to its proper design, starting from the cubature, construction, placement of the audience, together with the usage of specific linings, for instance, sound-absorbing panels or curtains. Changing acoustic conditions are a crucial element for any multi-functional hall. Important issue is also finding compromising solutions, connected to the principles of utility, general functionality, and economic conditions [5].

Jerald R. Hyde pays attention to the significant meaning of Leo Beranek's concept of the performance space that could be on the one hand, technical, and on the other, intimate with an attempt to specify objective attributes that can influence the quality of an architecture. One of the author's ideas is to define the sensation of intimacy in the context of acoustics, introducing the idea of experiencing, for example, music as an intimate and personal phenomenon. Beranek referred to the origins of music, to the times when it was performed by a small group of musicians in front of a small audience in a small room. Such a venue can evoke a sense of acoustic and visual intimacy; while a large hall can only aspire to achieve a similar effect if surfaces and spotlights can provide impression of a smaller space [6].

When designing a multi-use space, the need for an auditorium must be determined, the specific and form of which must be related to the main function of the hall, in accordance with the principles of sound reception and visibility.

Concepts connected to the form and the character of the audience can be found in numerous exemplary researches of Jin Yong Jeon et al. who analysed the co-dependency between the size and the form of stage and the acoustics in the audience, based on various examples included in their research. The surface of the stage floor and the walls changes, depending on the general volume that the stage takes in the concert hall, which impacts the overall sound absorption of the room. The factor of sound absorption of the internal finishing of the hall is a critical indicator, that estimates the sound-absorbing possibilities of a given room. The size and the shape of the stage also have a major influence on the acoustic parameters of a performance hall. The factor of sound absorption, together with the room surface being enlarged, has the most significant influence on reverberation, clarity, and volume of sound [7].

A large number of researches refers to the adaptation possibilities of already existing facilities, that despite being in use, cannot be called multi-functional. An example of such research is the Halil Z. Alibaba and Mesut B. Özdeniz analysis of the Lala Mustafa Pasa building. Its classically built auditorium (in terms of form) has faced problems with acoustics and listeners' comfort, that were caused by different ways of space usage. Excessive timing of reverberation does not provide proper conditions for listening to music, and in reality, it makes the music sound indis-

tinct. Research preparations, measuring of parameters, and acoustic simulations have allowed the researchers to create optimal solutions that could be applied. At the same time, it was established that there is no possibility of changing the placements of seats because only when they are permanently in place, the acoustics can work properly [8].

Designing small performance halls – case studies

The implementation of architectural and technical solutions in the process of designing small performance hall as multi-use space is presented on the example of three case studies – facilities located in Poland and designed by Koziń Architekci, architectural office, whose activities are focused on public utility architecture. Each of the objects has the character of a cultural facility with a multi-use space of similar size reaching 550 m². At the same time, each represents a different example of implementation in terms of functional program, form and aesthetics.

Overall architectural concept and the accessibility of the performance hall

The first case is a replacement interior design for the Mediateka in Wieliczka (1st floor plan with cross-section is visible in Fig. 1), which was built in 2017 according to strict architectural conservation guidelines as a two-story corner building with a classicist-style character, meant to supplement the square of the Konopka Family Palace. The client wanted to preserve the existing structure of the hall, which was planned as a cinema, improving its architectural and acoustic properties. The project aims at evaluating multi-purpose aspects of the hall by presenting it in two variants – cinema layout option and conference layout option.

The hall occupies the western wing of the building and was designed to be accessible both from the ground-floor hall and the first-floor foyer, which link both of the building's wings – the hall and the library. When the hall is to be used as a cinema, the audience enters through the ground floor and leaves through exits that lead directly outside. During other performances, the ground-floor entrance can be used by performers, who enter through a vestibule that is the foyer for the artists. The audience enters the hall through the 1st floor.

The second case is the Intangible Cultural Heritage Centre (ICHC) in Dąbrowa (underground floor plan with cross-section are visible in Fig. 2). The compositional layout of the building is composed of a sloping surface divided into “quarters”, which is a sort of a continuation of the extant form of the park. The facility combines a multi-functional hall with exhibition space, library, educational rooms and workshops. The main foyer is a space that directs visitors to the workshop space on the upper level, including the multipurpose room and educational halls. The hall's backroom is accessible from the lower level.

Third case is the Cultural Centre in Pszczyna (1st floor plan with cross-section is visible in Fig. 3), the facility opens in January 2024. The architectural concept is inscribed with its mass in the composition of the green park complex. The

space under a suspended green roof leads us into the homogeneous space of the object's lobby – an access to the main hall, cinema hall and checkrooms. Audience access to the hall is possible through doors at the level of the lower hall and the upper hall (in line with the roof garden level).

The stage-auditorium layout, flexibility and visibility assumptions

The Wieliczka Mediateka hall (Fig. 1) due to its implementation in an already existing structure had its limitations, which did not allow for the expected diversity. Finally, the hall has a fixed, monodirectional stage-auditorium layout – the effect of a modified design for an already existing stand. The auditorium features 184 permanent seats and 2 spaces for special needs persons. The entrance to the auditorium from the ground floor leads along two symmetrical vomitoria and one central passage. The second entrances lead from the vestibule located underneath the projector booth on the 1st floor. The stage, measuring 12 × 6 m, does not have a raised deck.

The replacement design introduced a change to the visibility of the stage. In the original version, the layout of the auditorium seats only provided proper visibility of the cinema screen. It did not meet visibility criteria for performances (stage floor visibility). The change to the elevation of the auditorium seats included making its lower section flatter, while elevating its upper section (based on the logarithmic visibility curve).

The change of the design of the existing hall meant there were limitations as to how the backstage section could be designed. The building's envelope had already been built, and the stage section was located at the back end of its functional layout. A solution was to create a small space for the performers underneath the auditorium deck (the space was obtained by changing the support structure of the auditorium from a steel one to a concrete slab), with entrance onto the stage through side vomitoria. This made it possible to separate the circulation of the audience from that of the performers. The entrance on the ground floor could be used as a waiting room for performers, while the audience would enter through the entrance on the 1st floor.

The flexibility of the layout is based on the use of black curtains, which can affect the acoustics, as well as the character of the interior itself. In cinema layout curtains cover the side walls. In performance layout curtains cover the screen on the frontal wall, with side walls featuring wooden oak panels that are uncovered.

The multi-functional hall in ICHC Dąbrowa (Fig. 2) is the space that was planned as a multi-functional flat-floor layout across the entirety of its area. The hall can accommodate an audience of 216 and 50 performers with the use of telescopic stands that can be folded and retracted into a prepared recess to achieve different stage-auditorium layouts. The telescopic stands were designed so as to provide visibility of the entire stage floor. Technical galleries were placed along the side and back walls of the audience stands. Apart from the hall itself, the exhibition space and rehearsal hall, both located in the immediate vicinity of the multi-functional hall, are also multi-functional in character.

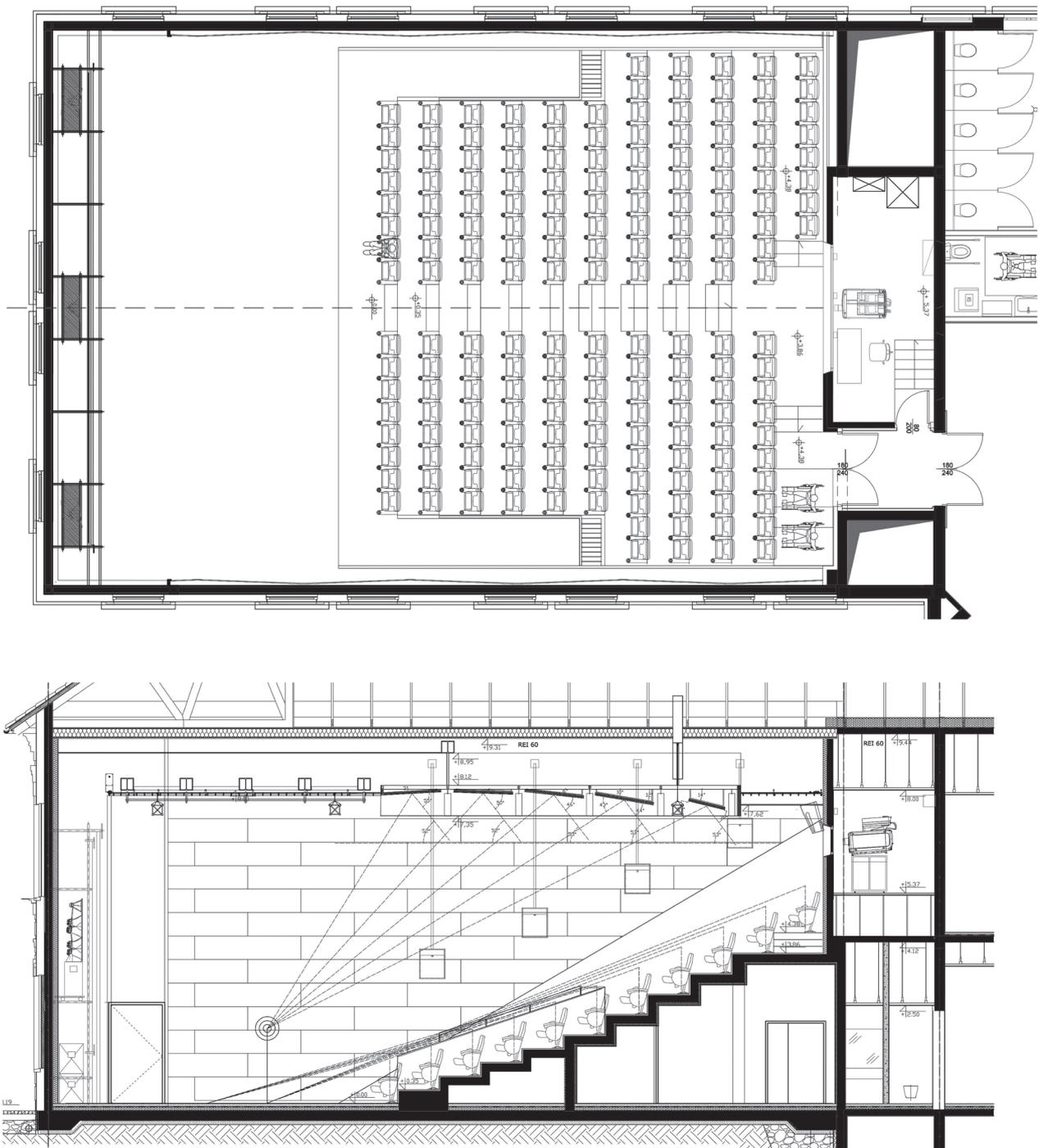


Fig. 1. The Wieliczka Mediateka, performance hall 1st floor plan with cross-section, designed by Koziń Architects (source: Koziń Architekci)

Il. 1. Mediateka w Wieliczce, sala widowiskowa – rzut pierwszego piętra z przekrojem, projekt Koziń Architects (źródło: Koziń Architekci)

They can be used during events held at the multi-functional hall, for instance as its foyer or reception hall. The back-stage section of the performance hall features a delivery space, staff facilities, technical spaces and dressing rooms.

The Main Hall in Cultural Centre in Pszczyna (Fig. 3) is divided by a diazoma into a fixed auditorium in the upper part and a movable folding seating in the lower part. The diazoma, from which one can get to the rows of the lower space, is recessed to the level of the first row of about 90 cm. This zone can be reduced by covering it with removable stage tops with simultaneous dismantling of the

first 2 rows (38 seats). This gives a chance for adjustable enlargement. From the transverse diazomata there are also wall mounted stairs leading to the upper part of the 1st floor auditorium (capacity 245 seats + 4 for the disabled) leading to the upper foyer level and to the technical gallery level. At this level it is proposed to increase the capacity of the hall by installing a temporary double row auditorium (second row elevated above the gallery level by approx. 60 cm) for max. 2×49 seats. Basic dimensions of the stage in the walls of the hall 17.00×9.70 – 11.70 m with the possibility of increasing its depth by reducing the size of the

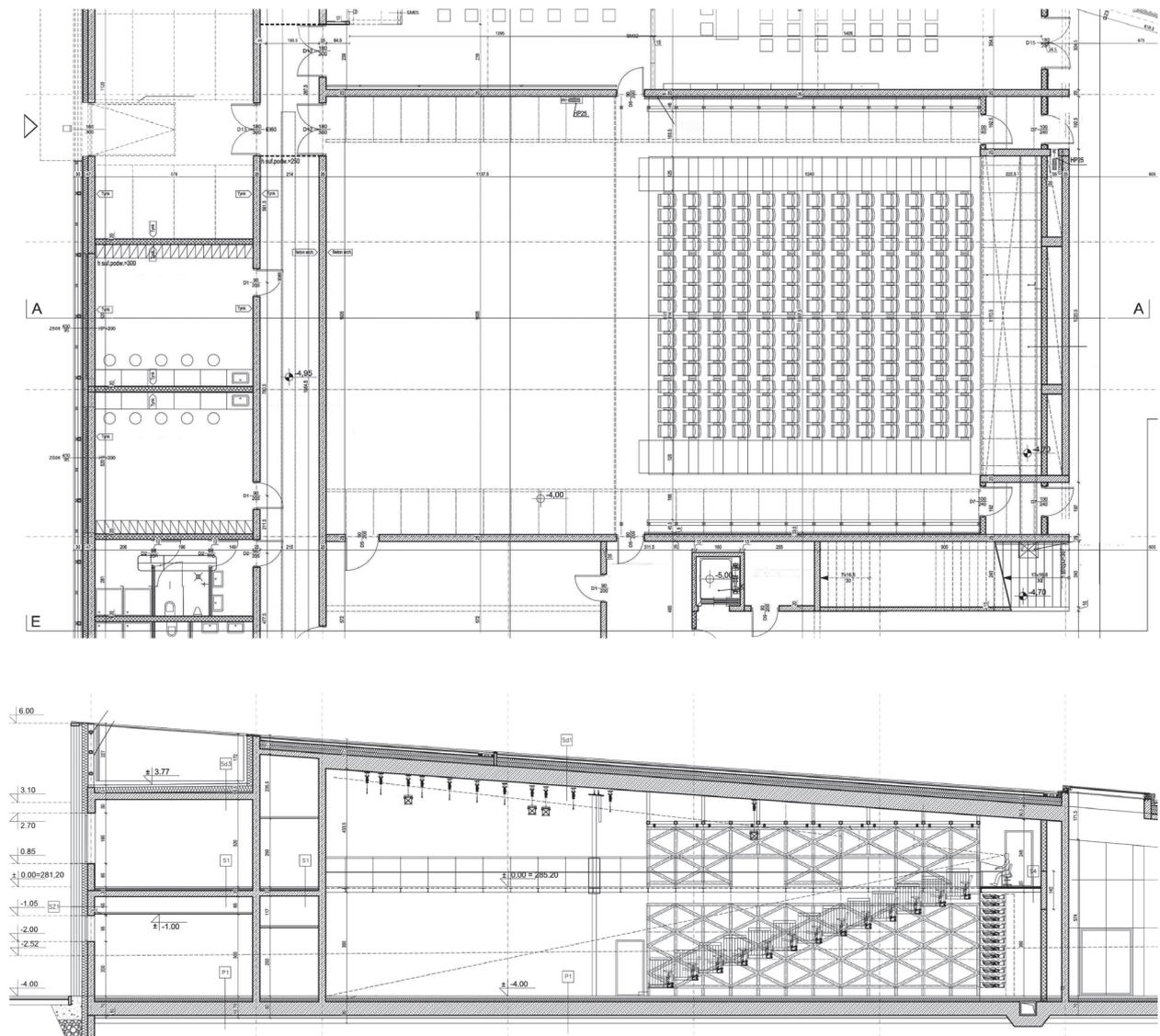


Fig. 2. ICHC Dąbrowa, performance hall – underground floor plan with cross-section, designed by Koziń Architects (source: Koziń Architekci)

Il. 2. ICHC Dąbrowa, sala widowiskowa – rzut kondygnacji podziemnej z przekrojem, projekt Koziń Architekci (źródło: Koziń Architekci)

audience in the lower segment. Entrances to the stage for artists and elements of show equipment in the side walls in the area of the fixed stage.

Interior acoustics, stage machinery, lighting and electroacoustic system

The interior acoustics design in indicated halls was prepared using the statistical method, while also using calculations and analysis based on the geometric method, referring to proven technological capabilities [9]–[14].

Acoustics in the case of the Mediateka in Wieliczka was a challenge because it involved taking into account the already constructed structure. The parameter that describes the acoustics of a given space is its reverberation time, whose optimal value depends on the function of the space and its internal volume. Reverberation time was calculated using a specialist predictive program used to design interior acoustics.

The Mediateka hall is a space with a floor area of around 270 m² and an internal volume of around 1898 m³, with a seating capacity of around 200 spectators. The volume coefficient is ca. 9 m³/person. The assumed reverberation time for this interior is between 0.4 and 0.9 s, depending on its configuration. The recommended reverberation time for the cinema hall (with curtains): 0.4 s. The recommended reverberation time for the performance hall (without curtains): 1.1 s. Reverberation time calculations were performed using the statistical and geometric method. Figure 4 presents the reverberation time obtained using acoustic curtains, while Figure 5 shows this value without acoustic curtains.

To optimise the interior's acoustics, the space of Mediateka hall was fitted with sound absorbing and scattering systems. The ceiling above the audience stands is composed of single-sheet 18 mm-thick plywood panels with a 5 cm thick layer of mineral wool with a density of 40–60 kg/m³. The ceiling above the remaining section of

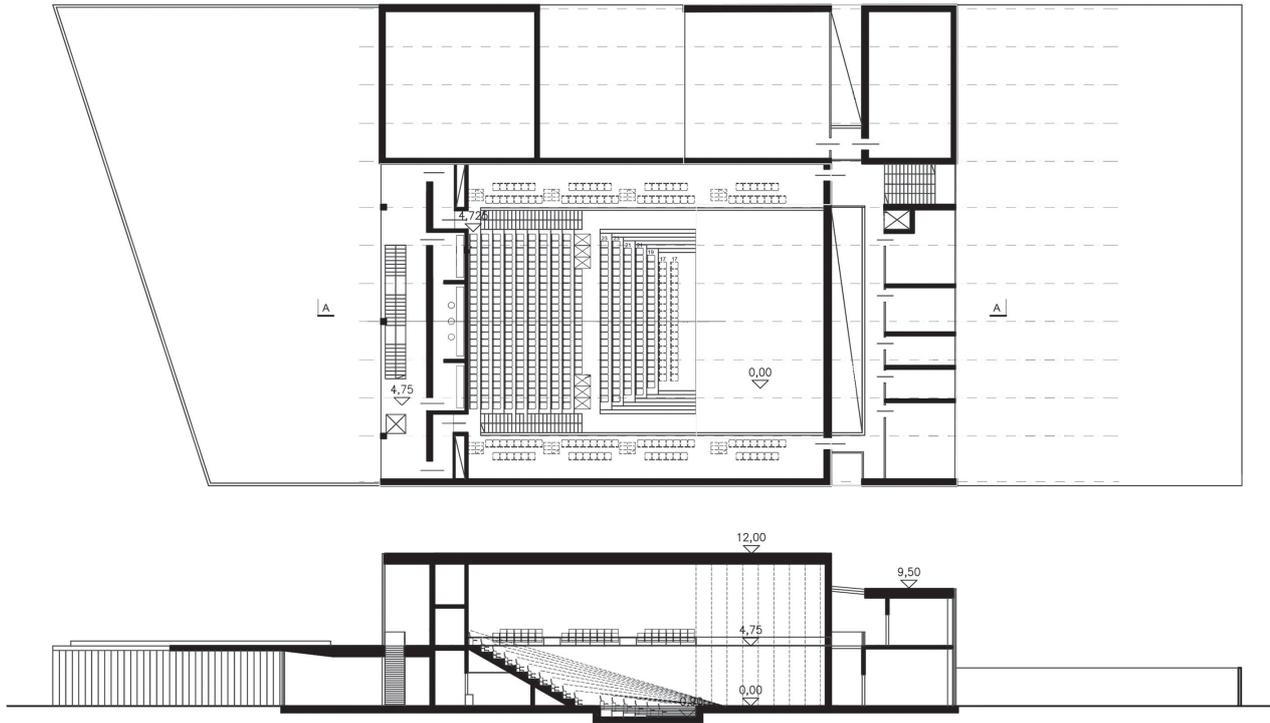


Fig. 3. Cultural Centre in Pszczyna – 1st floor plan with cross-section, designed by Kozień Architects (source: Kozień Architekci)

Il. 3. Centrum Kultury w Pszczynie – rzut pierwszego piętra z przekrojem, projekt Kozień Architekci (źródło: Kozień Architekci)

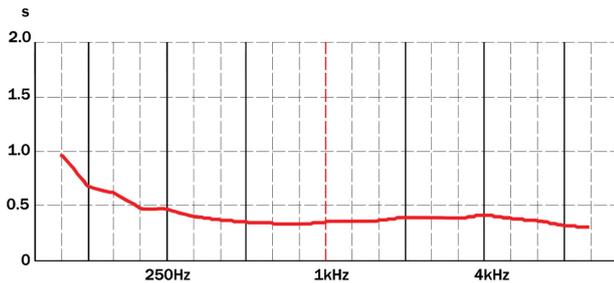


Fig. 4. The Wieliczka Mediateka, reverberation time in the performance hall – cinema option with the use of acoustic curtains (source: Manufaktura Technologiczna)

Il. 4. Mediateka w Wieliczce, czas pogłosu w sali widowiskowej – opcja kinowa z zastosowaniem kurtyn akustycznych (źródło: Manufaktura Technologiczna)

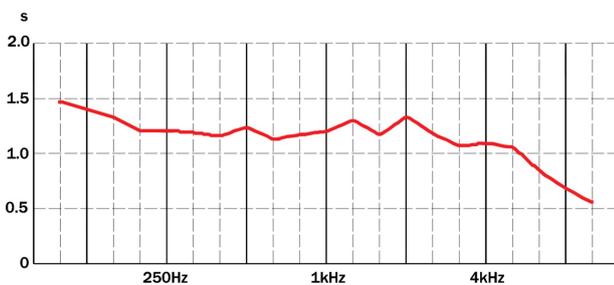


Fig. 5. The Wieliczka Mediateka, reverberation time in the performance hall – performance option without the use of acoustic curtains, designed by Manufaktura Technologiczna (source: Kozień Architekci)

Il. 5. Mediateka Wieliczka, czas pogłosu w sali widowiskowej – opcja spektaklu bez zastosowania kurtyn akustycznych, projekt: Manufaktura Technologiczna (źródło: Kozień Architekci)

the hall was designed as a modular suspended ceiling with a high-pass sound absorption property. The side walls were fitted out with sound reflection systems laid out in an alternating zigzagging pattern, made from laminated gypsum fibre boards filled with a 5 cm layer of mineral wool with a density of 40–60 kg/m³. The frontal wall with the screen, and the section of the side walls near the stage, along with the back wall of the hall, were covered with 15 cm thick slabs of mineral wool (density of 40–60 kg/m³) and non-woven fabric. The extensible draped acoustic curtain was made of a material with a density of 600 g/m². In addition to the acoustic importance, the use of black curtains also influenced the aesthetic perception of the room (see Fig. 6)

The main two functions cinema and performance, because of the character of the events it hosts, was designed to feature the following stage mechanic solutions with the installation of permanent supports. The structures of permanent battens are used to affix stage lighting. Support structures are also used to distribute cable infrastructure and power and signal outlets. The pipe grid is used to affix elements such as speakers or elements of stage design. The stage lights are affixed to lighting bridges. Lights can also be placed on the stage.

The cinema option will be a space predominantly prepared for film screenings, but also could be used to host verbal and musical performances. On the frontal wall there is a permanent screen with an in-built speaker set. A separate electroacoustic system was designed to facilitate this. In the music configuration, this system ensures an even sound coverage of the entire audience (± 3 dB) for 90% of the hall's area. The maximum sound pressure level is to be no lower than 105 dB, with the speech transmission

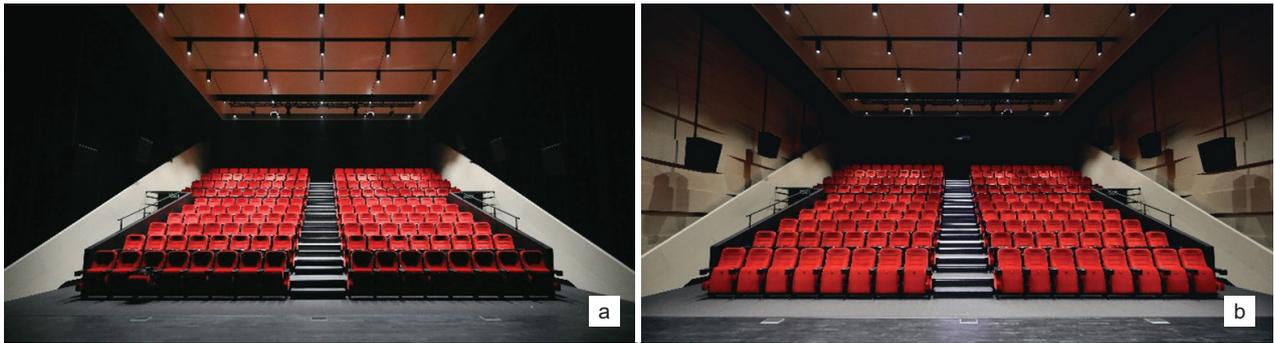


Fig. 6. The Wieliczka Mediateka, view of the performance hall: a) cinema option, b) performance option (photo by M. Turoń)

Il. 6. Mediateka w Wieliczce, widok na salę widowiskową: a) opcja kinowa, b) opcja spektaklu (fot. M. Turoń)

index being no lower than 0.6 for the entire audience area. The elements of the sound system can be used to remotely control signal parameters.

The technical and acoustic study in ICHC Dąbrowa was prepared with two sub-options: theatre + lecture and concert + presentation (when the audio-visual system is used). This is analogous to the situation in the case of the Wieliczka Hall, where it was decided that the hall should be acoustically adapted to two main activities. The selection and placement of the hall's acoustic adaptation structures should eliminate acoustic flaws, including echo and flutter echo. A calculation model was built using the CATT-acoustic v.8.0j computer program, based on the design and ongoing consultations. Differences in the reverberation time in the hall with the stands set up and acoustic control structures hidden or not, depending on the type of event, are shown in Figures 7 and 8.

A sound scattering-absorbing structure was composed with vertical panels with a width of 150 mm, affixed to a substructure mounted at a distance of 50 mm from the wall surface, with an infill of mineral wool and vertical gaps with a width of 1 mm. Fitted in the space behind a truss in the form of a horizontal strip of cladding with a height of 300 cm, placed in the available space of the side walls along the audience stands. Wall cladding was mounted to a system-specific support structure as plasterboard with square-shaped 12×12 mm 6% area perforation. Ceiling cladding was composed of mineral wool slabs with a thickness of 50 mm and a density of 50 kg/m^3 , affixed to a system-specific support structure. Mobile sound scattering and reflecting structure in the form of platforms enabling changes to the arrangement of the stage and adapting its size to the varied needs.

ICHC performance hall was to have a universal purpose in terms of the variety of events, and thus also in terms of technology. In order to meet the requirements laid out in the conceptual proposal concerning the performance layouts of the multi-functional hall, the design incorporates the use of the stage mechanic elements as decorative batten hoists, lighting bridge hoists, curtain system, stage platform system and sound systems. The multi-functional hall will be a space largely devoted to orchestral music concerts that do not require an electroacoustic system. In addition, hall will serve to host popular music concerts, theatrical perfor-

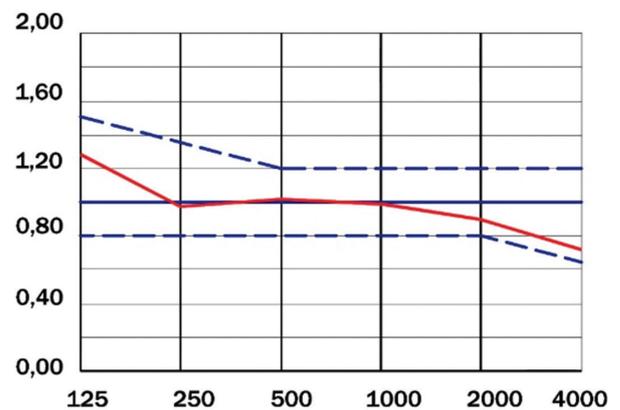


Fig. 7. ICHC Dąbrowa (theatre + lecture option), reverberation time in the hall with the audience stands set up and the acoustic control structures retracted (elaborated by J. Rubacha, K. Baruch, K. Brawata)

Il. 7. ICHC Dąbrowa, (opcja teatralno-konferencyjna), czas pogłosu w sali przy rozstawionych trybunach i schowanych konstrukcjach kontroli akustycznej (oprac. J. Rubacha, K. Baruch, K. Brawata)

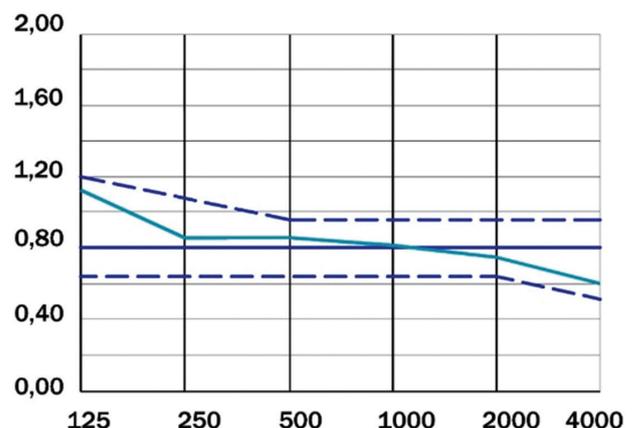


Fig. 8. ICHC Dąbrowa (concert + presentation option), reverberation time with the audience stands set up and acoustic parameter control structures extended (elaborated by J. Rubacha, K. Baruch, K. Brawata)

Il. 8. ICHC Dąbrowa (opcja koncertowo-muzyczna), czas pogłosu przy rozstawionych trybunach i rozbudowanych konstrukcjach kontroli parametrów akustycznych (oprac. J. Rubacha, K. Baruch, K. Brawata)

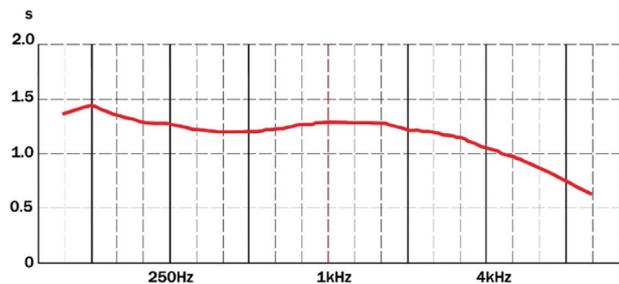


Fig. 9. Cultural Centre in Pszczyna – reverberation time diagram (elaborated by T. Ruszczyk, Ł. Gorczyca, M. Klimczuk)

Il. 9. Centrum Kultury w Pszczynie – wykres czasu pogłosu (oprac. T. Ruszczyk, Ł. Gorczyca, M. Klimczuk)

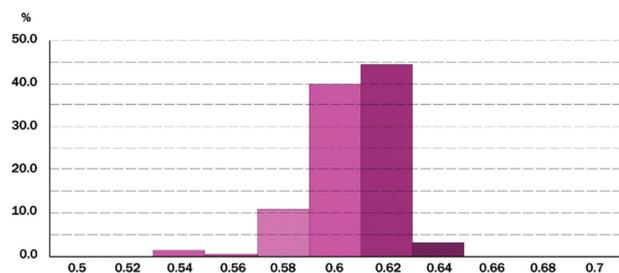


Fig. 10. Cultural Centre in Pszczyna – STI schedule (elaborated by T. Ruszczyk, Ł. Gorczyca, M. Klimczuk)

Il. 10. Centrum Kultury w Pszczynie – harmonogram STI (oprac. T. Ruszczyk, Ł. Gorczyca, M. Klimczuk)

mances, verbal and musical performances, presentations, seminars and meetings (with use of a venue projector).

Acoustic design and stage technology for Cultural Centre in Pszczyna was prepared as a multi-purpose hall, so it must have a relatively short reverberation time while maintaining adequate sound strength. The reverberation time (Fig. 9) and the speech transmission index STI (Fig. 10) were calculated and used to assess the hall acoustics with spectators. This will allow a high degree of speech intelligibility to be achieved, which is necessary.

Therefore, based on literature recommendations, the assumptions were made:

Table 1. Cultural Centre in Pszczyna – the reverberation time calculations (elaborated by T. Ruszczyk, Ł. Gorczyca, M. Klimczuk)
Tabela 1. Centrum Kultury w Pszczynie – obliczenia czasu pogłosu (oprac. T. Ruszczyk, Ł. Gorczyca, M. Klimczuk)

Parameter	Recommended value
Reverberation time RT60, 500 Hz	1.3 s
Non-uniformity of the reverberation time characteristics	
63 Hz÷125 Hz	+70/-20%
250 Hz÷500 Hz	+40/-20%
1 kHz÷2 kHz	+20/-20%
4 kHz÷8 kHz	+20/-40%

- the reverberation time of an empty auditorium at frequencies from 125 to 4000 Hz will be about 1.3 s, with a balanced characteristic for medium and high frequencies
- according to Table 1,
- achieving the values of the speech intelligibility index recommended for auditoriums,
- with uniform distribution over the entire auditorium and gallery area,
- eliminating acoustic defects,
- use of absorbing, dispersing and reflecting structures on walls and the ceiling.

Due to hall functionality, a low level of acoustic background is required in the hall. For this reason, it is recommended that all vertical partitions of the hall should have acoustic insulation $RA1 = 61$ dB. The wall made of reinforced concrete, 30 cm thick, has such a value. The wall dividing the technical gallery and sanitary facilities will be built in reinforced concrete technology and will be 20 cm thick, which ensures acoustic insulation value $RA1 = 56$ dB. The entrance to the auditorium leads through vestibules, which serve as acoustic sluices. Surrounding the auditorium with the sound engineer's booths, store-rooms and technical rooms, which do not generate high levels of sound pressure, provides additional protection against noise from outside the building and separates it from the auditorium.

The Main hall in Cultural Centre in Pszczyna was modelled in a prediction program that automatically calculates the absorption balance for the interior. For the simulations, an omnidirectional source emitting 1,759,000 sound beams with a duration of 810 ms was placed at the centre of the stage at a height of 1.5 m. The calculations were performed on the auditorium surface at a distance of 1.2 m from the ground, corresponding to an example seating arrangement.

The following solutions are used in order to achieve the assumed parameters:

- on the back wall (behind the audience) UN-1 low frequency panels made of wood-based board (MDF with veneer on the face side or plywood) 15 mm thick with round hole perforation on a 50 mm mineral wool layer; on the central part, on both sides of the window, 400 mm wide panels deviated from the axis by 19° and UN-2 low-frequency panels made of wood-based board 15 mm thick with round perforation,
- on side walls of mezzanine UN-1 low-frequency panels made of wood-based board 15 mm thick with round hole perforation on a layer of 50 mm mineral wool; total construction height 100 mm; panels with total height 3 m on the front wall of the Main Hall – full sound-proof UP-1 panels made of wood-based board, 15 mm thick, on a layer of 50 mm mineral wool,
- on side walls full sound absorbing UP-1 panels made of wood-based board 200 or 100 mm wide and 15 mm thick on a 50 mm mineral wool layer; total construction height varies from 100 to 150 mm from floor to door height; construction height above door 150 mm,
- on the ceiling US-1 panels made of 100 mm rock wool with glass fibre lining, mounted directly to the ceiling,
- US-2 sound-reflecting panels made of plywood, 30 mm thick, suspended under the ceiling, pre-sloped,

- armchairs with medium upholstery,
- parquet flooring.

The Main Hall in Cultural Centre in Pszczyna is also distinguished by its special rooms for electro-acousticicians, lighting technicians and interpreters, which are located on the upper level on two technical galleries. From the side galleries it is possible to operate stage lighting projectors, acoustic equipment elements and projected wall banners for reverberation time control. In order to meet the requirements of the design assumptions in terms of staging arrangements, the design includes the use of the stage mechanization elements as extractors for decorative stiletto exhausts, lighting bridge with side lighting structures, loudspeaker system, curtain system. The floodlights will be mounted on lighting bridges, balcony balustrades and the auditorium lighting structure. In addition, spotlights will be able to be placed on the stage floor.

Discussion

Due to the differences in the specificity of the buildings, the needs of their users or local conditions, different multi-use designs were prepared according to the definitions of multi-purpose (Wieliczka Mediateka, Cultural Centre Pszczyna) and multi-function (IHC Dąbrowa). Comparison of the basic parameters is presented in Table 2.

It can be seen that multi-purpose is a more targeted assumption when considering client guidelines. This allows architects to literally name the most relevant functions and therefore also to precisely select design decisions. Further, it can be noted that with multi-purpose there is a fixed auditorium, whereas with multi-purpose there is a more favourable design approach with an open plan and movable auditorium. In this case, telescopic auditorium solutions are popular, as they quickly allow the layout of the auditorium

Table 2. Comparison of the parameters of the halls (elaborated by M. Gierbienis)
Tabela 2. Porównanie parametrów sal (oprac. M. Gierbienis)

Building	Wieliczka Mediateka	IHC Dąbrowa	Cultural Centre Pszczyna
Qualification	multi-purpose	multi-functional	multi-purpose
Function	theatre, cinema, concert, conference	theatre, concert, dance, conference	theatre, concert, dance, conference
Hall floor area [m ²]	~270	~415	~500
Number of seats	fixed 186	variable, max 216	fixed 240 + removable 141 + 110 in technical galleries
Hall height [m]	3.40–9.20	7–8	6.5–11.2
Hall volume [m ³]	~1900	~3110	~5100
Auditorium shape	fixed auditorium	retractable telescopic stands	fixed + moveable auditorium
Audience size [m]	12 × 6	2 parts: 12 × 10	18 × 14 (fixed + removable)
Reverberation time T500-1 kHz	regulated 0.4–1.1	regulated 0.8–1.0	1.3
Stage mechanic systems – lower	none	stage platforms	none
Stage mechanic systems – upper	fixed lighting bridges, pipe grid	hoists, movable lighting bridges, pipe grid, technical galleries	hoists, movable lighting bridges, pipe grid, technical galleries
Curtains	covering the screen/horizon	stage curtain/horizon	stage curtain/horizon
Electroacoustic systems	independent cinema speaker system	shared speaker system	shared speaker system
Screening	fixed cinema screen + projector, foldable screen	foldable screen	none
Stage access	from the audience, from outside	from the waiting room near the stage	from the waiting room near the stage
Auditorium access	2 levels	1 level	2 levels
Backstage	none	storage spaces, dressing rooms, recording studio	storage spaces, dressing rooms, workshops,
Sliding walls	none	none	none
Audience services	hall, cloakroom, toilets, coffee shop	hall, cloakroom, toilets	hall, cloakroom, toilets
Accessibility to special needs	provided	provided	provided
EA station	projector booth	technical gallery	technical booth

to be changed while being easily stored. A similar situation to that of the audience operates in the topic of the stage. Due to the variable nature of the interior, a fixed stage does not allow the layout to be flexible. At the same time, even in the case of the discussed case studies of multi-purpose halls, the stage as we know it from typical theatre or philharmonic buildings is abandoned. It is possible to use a mobile stage, constructed from modules.

Based on the information presented in Table 2, it can be observed that despite the comparable number of audience seats and a rectangular floor plan shape, the halls substantially differ in the nature of their stage-auditorium layout, acoustic assumptions and technological fittings. The shape of the hall depends on its location within the functional and spatial structure of the building. However, it can be assumed that it is the rectangular shape that is the simplest and thus allows the space to adapt more easily to varied use. In each case, the acousticians analyse specific design assumptions and adapt their solutions to the situation with use wall and ceiling cladding, or other elements to diffuse or reflect sound.

In Wieliczka Mediateka, a fixed auditorium was designed, accessible from two levels, in addition to acoustic curtains on side walls, limited technological stage equipment, with an independent cinema projection and sound system. In this example there is no backstage section behind the stage itself, which is a result of previous design assumptions that placed a cinema in the back-end section of the building, across its entire span. The diversification of functions also changed the way the hall was to be accessible to the public, allowing separate access to the hall for spectators and performers. When combining the functions of theatre and cinema, it is worth noting the different nature of the visibility curve for the audience. In the case of these shows, the viewer's point is different, and so the construction of the auditorium should follow suit – so that the viewer can see everything that is happening on stage, while at the same time, in the cinema option, they can comfortably see the screen. Therefore, taking into account the functioning of the auditorium for these two purposes, it is necessary to analyse such a visibility curve which will achieve the desired effect in both options. It is also a challenge for acousticians, as the specificity of cinema is a great sound system, and in the case of theatre performances, the actor should be heard comfortably by every participant of the event.

A hall without a fixed auditorium, but with a flat floor and a height that allows comfortable use is a good choice from the point of view of the flexibility idea. The performance hall in ICHC Dąbrowa was planned from the outset as a multi-functional space with the decision to add mov-

able telescopic stands. The idea behind the creation of the Cultural Centre in Pszczyna was to offer the community a modern facility that could be active all year round, and in which various events could take place, both those that happen less frequently in small towns, such as theatre performances, and those popular – concerts or casual meetings. The auditorium consists of a fixed auditorium, but is also partly demountable, allowing for minor rearrangements or the widening of the stage.

Conclusions

The paper confirmed the complexity of the problem of the design of modern performance halls as a multi-use space. This complexity is not confined to high-capacity halls, applying to small layouts as well. Designing smaller performance spaces is a challenge related to economics and budget, take into account compromises resulting from combining, sometimes divergent, functions. Design decisions are associated with a wide array of factors and therefore require that starting assumptions be precisely formulated. The key element of the design of multi-use halls is to precisely define the main function and the supplementary ones. Therefore, it is necessary that the design team cooperates with future users during the stage of formulating design assumptions. The compilation of suitable solutions, adaptation to the capabilities, expectations of the client and close cooperation with acousticians are the most important tasks in the design of multi-functional facilities. The potential for multi-functionality also has its limits, which are mostly related to economic and technological factors. At the same time, it is a contribution that pays off in terms of achieving flexible design.

To achieve flexibility in the use of the rooms, it is recommended to introduce a partially demountable auditorium or foldable bleachers, which nowadays allow for a wide variety of arrangements, enhancing the creativity of use. Movable systems of electro and acoustic technology allow for dynamic changes in the perception of space depending on whether the event uses the spoken word or requires sound amplification. Some solutions, such as foldable walls and curtains, in addition to separating and changing the acoustics, can also significantly influence the aesthetics of the rooms.

Expanding the knowledge base in the design of small performance halls that are versatile in use is an important issue from both a research and architectural-implementation perspective, as a response to the needs of modern cities and sustainable development.

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Streszczenie

Wieloużytkowość małych sal widowiskowych – studia przypadków nowoczesnych obiektów kultury w Polsce

Od współczesnej architektury oczekuje się nie tylko spełniania celów funkcjonalnych i wysokiej jakości estetyki, ale także uwzględniania zmieniających się potrzeb społecznych, co jednocześnie wpisuje się w trend budownictwa zrównoważonego. Istotne jest więc uwzględnienie przy realizacji nowych inwestycji, zwłaszcza w małych miastach, idei wielofunkcyjności. Tematem artykułu jest analiza trzech budynków w Wieliczce, Dąbrowie i Pszczynie, w których w różny sposób pomyślano o kryterium wielofunkcyjności. Omówione przykłady stanowią jednocześnie wartość zarówno dla badaczy, jak i inwestorów oraz projektantów, pokazując konkretne rozwiązania architektoniczne, estetyczne i technologiczne związane z realizacją małych sal widowiskowych – zagadnienie sporadycznie podejmowane w publikacjach naukowych. Nadrzędnym celem autorów niniejszego artykułu było zwrócenie uwagi na konieczność indywidualnego podejścia w procesie projektowym i wielokryterialnego poszukiwania optymalnych rozwiązań projektowych dla sali przy jednoczesnym odejściu od standardowej unifikacji. Ostatecznie realizacja małych sal widowiskowych o charakterze wielofunkcyjnym wpisuje się w idee zrównoważonego rozwoju, który w założeniu łączy potrzeby teraźniejszego pokolenia ze zdolnością do zaspokajania potrzeb przyszłych pokoleń.

Słowa kluczowe: sala widowiskowa, zrównoważony rozwój, obiekty wielofunkcyjne, obiekty wieloużytkowe

