

Ergonomic Solutions for Large Hotel Spaces

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ABSTRACT

Apart from providing accommodation and fulfilling basic human needs, contemporary hotels are places of meetings, business agreements, conferences, symposiums or celebrations of important life events. In order to provide sufficient space for large groups of users coming at the same time, hotels are being equipped with great halls, vast rooms, and wide corridors. These types of interiors raise certain issues, such as: sufficient lighting, proper acoustics, user and fire safety, high wear rate of finishing materials, or comfort of people with disabilities. However, these problems are usually treated as secondary concerns, whereas the focus is often on an interesting architectural design, implemented without sufficient specialist knowledge on acoustics, visibility or fire protection. This study is a closer analysis of the aforementioned problems, based on case and literature studies. The paper also proposes guidelines which can prove useful in designing or refurbishing large hotel spaces.

Keywords: Ergonomics of hotels, public space in hotels, large hotel spaces, hotel design

INTRODUCTION

The importance of public spaces in contemporary hotel design is connected with the development of American luxury hotels in the 1920s and 1930s, such as “Waldorf Astoria”, “Plaza Hotel”, “New Netherlands”, and later in the 1960s, with John Portman’s first atrium hotel, i.e. “The Hyatt Regency Atlanta” (Rutes, Penner, Lawrence, 2001), (Nowoczesne [...], 2010). During this period the number of congresses in Europe was on the increase due to several factors, e.g. the end of the First World War, economic development of countries, new media, and popularization of railway (Chmielewski, 2010). But it was not until the 1980 that the conference function became an important design factor (Rutes, Penner, Lawrence, 2001). Public spaces of those times are still perceived as the most representative examples of hotel design, where guests could rest from the urban noise. The external and internal places are available not only for guests, but also for the local community, thus serving an important function in the city structure and helping the buildings to better fit into the urban context. Moreover, architectural designs of public spaces must be easily recognizable and serve as a landmark with features that are representative in character. In their search for a timeless and distinct architectural form, architects must not disregard the proper spatial and functional program, integral and accessible design and the objectives of ergonomics.

Large hotel spaces integrate many functions and activities: reception and registration, movement and waiting, recreation and leisure, meetings and conferences, work, communication, information, gastronomy, entertainment, shopping, health and beauty, etc. Public areas may be divided into three categories: those accessible for everyone (e.g. external squares and greenery systems, driveways, parking lots, entrance vestibules, reception and recreation halls, shops, services, gastronomy, entertainment), those accessible for designated people (e.g. conference venues, business centers, pools, SPA and Wellness centers, selected entertainment services), and service areas (e.g. cloakrooms, restrooms, baggage repositories, offices, archives, storage areas, technical rooms, etc.) What is especially interesting in the ergonomics of these solutions is that they are no longer connected to the psychical and

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psychological needs of each individual, but they should be analyzed in terms of movement streams of large groups of people. Such an understanding of circulation is strictly connected to the psychology of crowd and possibility of panicking.

Methodology

The focus of the paper is on large public spaces of chosen European and American hotels situated in cities, due to their scale and advanced architectural features. Special attention was given to the reception area and common halls, conference venues, corridors and small catering areas in the context of pedestrian traffic, natural and artificial lighting, visibility, proper sound propagation, user and fire safety, colors and textures of finishing materials and comfort of people with disabilities. Facilities like pools, SPA and Wellness centers, shops, clubs, large restaurants, game areas have been purposely omitted, due to their high diversity and complexity of the studied field. The case studies and literature have been chosen to cover different aspects of the subject-matter and to include the most representative research material. Since the focus is on contemporary issues, the choice of buildings was limited to those erected within the last 15 years. The study adopted the following research methods: literature study, case study, analysis, graphical analysis, critical analysis, synthesis, and comparative synthesis.

REQUIREMENTS AND SOLUTIONS

Entrance and mixed-use zones

The entrance hall is especially important as it is where the activities of all users concentrate for the 24 hours per day. It functions not only as a reception area and information point, but is also a zone for waiting, meetings and directing users to other places of the building. It is usually joined by corridors, staircases and elevators and can also be connected to the recently popular mixed-use space, instead of just being a simple sitting lounge (see figures 1 and 2). This type of area is usually vibrant and full of people performing different activities. Therefore, in contemporary designs it should be an integral part of the reception area. Such a solution creates an impression of 'city buzz' inside the halls, connects streets with the interior of the building and allows the general public to gain access to services for 24 h (Nowoczesne [...], 2010). To strengthen the effect of liveliness, small coffee shops, bars and refreshment lounges (see figure 3) are blended into the functional program. Their interiors are open to the halls and the exterior in the form of an outdoor terrace, garden or a simply by placing chairs and tables outside on the pavement. An important element of today's mixed-use spaces, apart from comfortable chairs and sofas, is WiFi connection, which provides people with constant access to their files, entertainment services or communication tools. Some of these spaces also include small shops, services, vending machines, media access (TV/radio), press kiosks, information and exhibition stands, art pieces – sometimes available for sale (Nowoczesne [...], 2010), plants and computers. Today, the reception and registration area functions rather as a background for the aforementioned mixed-use spaces.



Fig. 1 Entrance area: on the left - reception hall and open staircase in Trump International Hotel & Tower Chicago, USA, in the middle: open staircase, reception area, on the right: elevator lobby all in "Sofitel Chicago Water Tower", USA (2013)

When designing lobbies it is crucial to take into consideration the flows of people, which intersect at different points of the interior. The Polish regulations (Rozporządzenie [...], 2002) state the following:

- Pursuant to evacuation requirements § 237 point 10 and §242 point 1 and 2, the width of one route in a room must be 60 cm for every 100 people, but it cannot be smaller than 90 cm (or 80 cm if only Sustainable Infrastructure (2018)

3 persons can be inside the room),

- Pursuant to evacuation requirements § 237 point 10 and §242 point 1 and 2, an evacuation route must be at least 1,40 m wide (1,20 m if less than 20 people are evacuated),
- Pursuant to § 236. point 6, when calculating the aforementioned parameters for lobbies (halls), conference rooms, catering and entertainment venues, lounges and recreation areas, the assumption is that there is one person for each square meter.

Therefore it seems crucial for corridors to be at least 1,40 m wide, while transition passages should have a width of at least 1,20 m. It is also important for the height of the representation zone to stress the function and create a feeling of spaciousness. According to the aforementioned regulations (Rozporządzenie [...], 2002) § 72, point 1, in Poland, the height must be at least 3,3 m, but usually, due to the requirements of open-plan designs, ceilings are suspended at heights ranging between 5-12 m. In some hotels, lobbies are not only two stories high, but span all levels of the building.

Of equal importance to the spatial regulations are materials and finishing. Colors and textures support proper light distribution, while their density and thickness determine the sound parameters. By using the proper material distribution in the whole interior it is possible to absorb the excess of sound energy, generated by steps, talks, appliances and electronic devices, and eliminate echo. Moreover, it should generate lateral reflections to help people locate sound sources and their own position inside the room (especially in the case of blind people). All the implemented solutions must also be resistant to intensive use, keep good look through time, be fire resistant, be easy to clean and not produce any particles or fumes harmful to human health. These solutions cannot emit unpleasant smells under any circumstances. Due to all of the aforementioned requirements, optimal material distribution assumes the application of absorbent materials, which can be covered by sound-transparent meshes or hidden behind perforated panels, to cover ceilings, and reflective surfaces to cover walls. Floors may be finished with hard but non-slippery, specialized materials. However, for vast open spaces an absorbent covering is recommended. It should be stressed that thick carpet hair or its edges are hazardous for people with disabilities. Previous articles described optimal dimensions and requirements of the reception area and other furniture which takes into account the needs of people with disabilities (Trocka-Leszczynska, Jablonska, 2013).

In the case of public spaces that are located deep in the hotel interior, natural lighting is additionally distributed via fully glazed walls, additional atriums inside the buildings or sunlight wells. Light waves are also diffused with the use of reflecting surfaces – walls, floors and ceilings – or glass and mirrors, which serve as decorations and functional elements, e.g. balustrades (see figure 1, 2 and 3). In large spaces these solutions would have little effect on space, hence artificial lighting is used in the form of general lighting, e.g. large lamps, chandeliers, glowing surfaces, and additional lighting, e.g. light points scattered on walls and ceilings, sconces, light strips, glowing signs and furniture (see figure 1 and 2). This effect is also maximized by specially designed scattering surfaces and reflections.

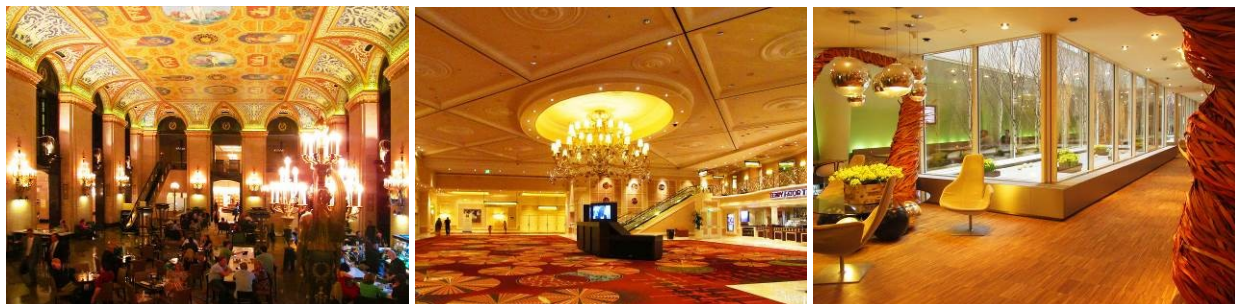


Fig. 2 Mixed-use space: on the left – space in use at "Palmer House a Hilton Hotel" in Chicago II., USA, in the middle – "The Mirage" hotel, Las Vegas, USA, on the right – "Yasmin" Hotel, Prague, Czech Republic (2013)

Important elements of mixed-use entrance area and public space in contemporary hotels include small bars, lounges, coffee shops and stations, clubs, etc., which give a sense of intimacy for conversations and business meetings (see

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figure 3). In larger facilities there can be several of them, apart from large restaurants, and each can have a different interior arrangement, which is also consistent with the overall hotel design. Since full meals are not served in such places, there is no need to use typical dining tables and chairs. Instead, comfortable armchairs, sofas, and stools with small tables can be used. Crucial to the design is the unique idea for space, which, at the same time, must provide appropriate sound conditions so as to enable quiet conversation. This is why the number of seats should be limited and interiors should not be too large. If a room does not have such parameters, additional visual and acoustical partitions are used, but the best solutions are offered by optimal architecture. In these areas the general lighting can be easily dimmed and local light sources become the most important. Because these zones are usually strictly connected to the exterior, there is an opportunity to allow deep natural light to penetrate the interior. However, in order to maintain the sense of privacy, sunlight can be diffused or dimmed. It has been observed that warm and saturated colors with soft textures are preferred in interior design, even though they might wear quite fast. Thus, the assumed upgrade and refurbishment cycle is much shorter for these areas than in other sections of hotels (Nowoczesne [...], 2010). It is also important to connect small catering services with individual restrooms of those in the main lobby and with specialize kitchen services, which are connected to the restaurant services or are separate, depending on the spatial layout of the building.



Fig. 3 Varied catering areas: on the left – 1-st floor bar in Trump International Hotel & Tower Chicago II., USA, in the middle – lobby bar in "Sofitel Chicago Water Tower", USA, on the right – hotel restaurant in Las Vegas, USA (2013)

Conference centers

Conference halls are a very important element in the functioning of hotels, especially in terms of economy. As Chmielewski (Chmielewski, 2010) notes, the larger the symposium room available at the facility, the higher up it will rise in the rankings. Halls serve congresses, conferences, symposiums, lectures and trainings, meetings or political events, which can provide full occupancy of hotel rooms. What is more, large gatherings allow catering and other services to be used to their full potential. Literature (Nowoczesne [...], 2010) notes that some centers can gather even up to a few thousand people. The general design of these spaces should limit possible distractions (Rutes, Penner, Lawrence, 2001). Thus, a venue must be distanced from noise factors, but at the same time it needs to be close to the entrance area so that it is easy to find. This is why conference zones are accessible through a separate entrance hall, which in turn may be used for registering participants, providing information, organizing exhibitions or serve as an additional discussion and recreation zone. Considering the fact that many guests may come from outside the hotel, the conference hall must have an additional entrance and a cloakroom. This place also helps to control the number of incoming people, and conference zones are used in a half-private manner.

Depending on the layout of conference rooms, the hall may be in the center with entrances arranged along its walls, or have the form of wide corridor with meeting places situated on one or both sides (see figure 4). In the case of large facilities usually both of the aforementioned solutions are used in combination, and sometimes additional halls are added, which creates a cluster-like system. When creating such spaces, it is crucial to separate the streams of movement of incoming guests from outgoing guests, as well as from people waiting in the foyer or corridors. The aforementioned circulation should also be detached from evacuation routes, which must always be available without any obstacles. This problem is commonly solved by placing the conference complex on the ground level or situating the foyer next to a representative and open staircase, connected to an elevator lobby, and by closing off the evacuation route and staircases with fireproof walls and doors. The whole arrangement must be well-designed, especially

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if there larger halls are to be sub-divided by movable partitions.

The placement of the banquet area is strictly connected with the proper circulation of users. Nowadays, designed as a buffet, it is open and provides an additional attraction during meetings. Though the banquet should be at a distance from the main communication routes, it must be clearly visible from these paths. Such solution helps conference guests to orient themselves and quickly access the refreshments. To increase the quality of rest in them, banquet zones are located near outdoor terraces, balconies or large openings with views of greenery. It is also crucial to allow sufficient amount of daylight in the hall during breaks because conference meetings usually require that the interior is fully shaded. Natural lighting is needed not only to keep guests alert but it also provides psychological comfort, allowing better concentration on the activities that follow. The banquet zone must be close to the catering section of the hotel or it may be connected to it via kitchen elevators. In many of the studied arrangements additional kitchen services may be designed on the conference floor, where refreshments can be heated or kept in refrigerators, depending on the serving requirements.

As far as additional service areas are concerned, they can cover large spaces, sometimes even up to 1/3, 1/2 of the whole venue. The restrooms usually take a lot of space and must be designed for the maximum number of people that the venue can hold. Thus, they should be divided into smaller modules and located near the main entrance hall, banquet zone and meeting rooms. Apart from standard solutions, such as women's and men's rooms, they must be accessible for people with different disabilities, the elderly, mothers with children and pregnant women. Service rooms, such as offices, quiet zones, workrooms (see figure 4), press rooms, recording studios, translator cabins equipped with computers, internet access, telephones, and faxes, should also be available to the conference participants. Zoning of different functional areas can be designed with the use of different materials, lighting and acoustical arrangements. Public areas can be painted brighter colors, with even, reflecting surfaces, while quiet rooms can be marked by darker shades, with dimmed general lighting and softer, absorbing materials. This way, public spaces will be more reverberant, favoring movement and louder conversations, while work places will be silent and allow for concentration.



Fig. 4 Conference service space - on the left: a wide corridor leading to small conference rooms in Trump International Hotel & Tower Chicago II., USA, in the middle: the conference foyer in Kiproitis Panorama & Siuts Hotel, Kos, Greece, on the right: workroom in "Sofitel Chicago Water Tower", USA (2012, 2013)

Conference halls vary in shapes and sizes. The general typology divides them into large and small. Conference rooms of the first type usually have fixed seats in different combinations. A plenary hall will have a central stage with the auditorium placed around it on an upward slope. In spite its acoustical disadvantage the circular plan is popular as it offers perfect sight lines and direct sound propagation. It also has an important psychological aspect, providing sense of community among participants, because in a circular layout everyone feels equally important and can see each other. Another variant of this configuration is the semi-circular auditorium (see figure 5). The shoe-box shaped auditorium with rising tiers of seats offers better acoustics but is less advantageous in terms of visibility and psychology. A simpler version of this configuration is the ballroom (see figure 5) with a rectangular plan that allows for full flexibility. However these cannot accommodate plenary sessions.

Each venue usually offers a combination of major and minor halls in a single-floor or multi-floor system (see figure 6). One factor that is common for all examples is the requirement of flexibility, which was copied to conference

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facilities from experimental theatre designs (Chmielewski 2010) of the 1960s and 1970s. Although in the case of special interiors such as performance halls, changes in the space turned out disadvantageous to sound quality, in conference venues it is desirable to introduce slight modifications that provide economic benefits. The need for change is visible not only over time, e.g. over a decade, but also when the requirements change regarding usable area (e.g. a concert immediately followed by a training): furniture, equipment, lighting, climate and acoustical conditions, all of which depend on the type of event. According to Chmielewski (Chmielewski 2010) the large halls can be made flexible in two different ways, either by using mobile walls, or by using changeable equipment. The author also stresses the ease of combining certain types of functions, such as: conference with education, banquet with exhibition and congress with culture. Apart from the chosen method for space transformation, changes require the proper location of technical building services, i.e.: heating, ventilation and air-conditioning inlets and outlets, light points distribution (both main and auxiliary i.e. desk lamps), switches, electrical and telecom sockets (data ports), fire-protection elements, including smoke-detectors, sprinklers, public address systems, emergency signs and lighting placement, etc. Some installations can be hidden under the floor, which seems a reasonable solution for computer and laptops. Other installations are fixed over suspended ceilings. There is also a possibility to use movable controls for lighting, power and audiovisual equipment (Rutes, Penner, Lawrence, 2001).



Fig. 5 Configurations of large halls – on the left: semi-circular plenary hall (fixed seating) in "Cesar's Palace" Hotel, Las Vegas, USA, in the middle: ballroom in banquet configuration in "The Mirage" hotel, Las Vegas, USA, on the right: rectangular conference hall in Trump International Hotel & Tower Chicago II., USA (2013)



Fig. 6 Spatial layouts of conference centers – on the left: single-floor system in Andel's Hotel in Czech Republic, on the right (3 drawings): multi-floor system in "Sofitel Chicago Water Tower", USA (drawings based on (Vickers 2005, p. 34), (Water [...], 2013))

Mobile walls can be used to divide any type of hall into two, four or multiple minor rooms, which can be accessed from existing or new corridors (see figure 7). Movable walls used in these cases can be slid from the sides of the rooms or rolled down from the ceilings. Such walls have to have the required acoustical and fire-safety parameters, which depend on local regulations and external conditions. However, it must be stressed that movable compartments cannot provide rooms with acoustics as perfect as permanent partitions (Rutes, Penner, Lawrence, 2001). According to Chmielewski (Chmielewski, 2010, p. 94) mobile furnishing can be divided into four groups in terms of flexibility:

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“multifunctional chairs and armchairs, multifunctional tables and work surfaces, movable acoustical walls, exposition screens and exhibition stands”. Other literature sources (Rutes, Penner, Lawrence, 2001) also add to this list: “stackable walls, presentation railings”.

With respect to the method of furniture placement in minor halls, the most popular configurations are as follows (see figure 8). The boardroom configuration is characteristic for its high standard with luxury chairs and elegant interior design. The open and closed circular configuration are based on a geometric figure, i.e. ellipse, oval, rectangle, circle, which is open on one end or closed. All of these systems can accommodate a small audience, seated along one or two walls. Another type is the classroom configuration – where tables and chairs are facing the speaker and the screen area. The auditorium arrangement has chairs furnished with movable pulpits, which also face the presenter. A less formal configuration includes the banquet and cabaret configuration with chairs and tables resembling a restaurant. The first configuration enables free conversations whereas the second - comfortable observation of the stage.

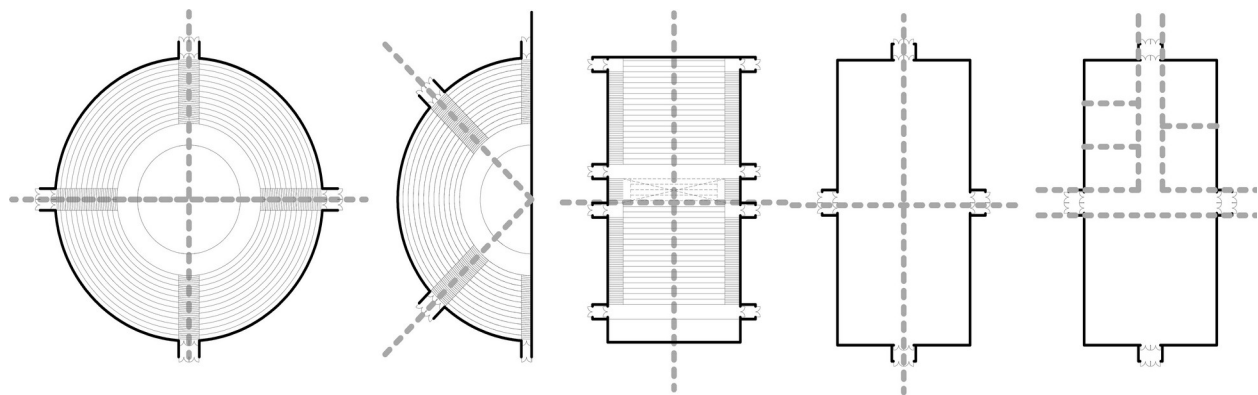


Fig. 7 Configuration schemes for major halls with possible sub-divisions - from the left: plenary hall (fixed), semi-circular auditorium (fixed), shoe-box shaped auditorium, ballroom divided into minor halls and meeting rooms (drawings made in 2014)

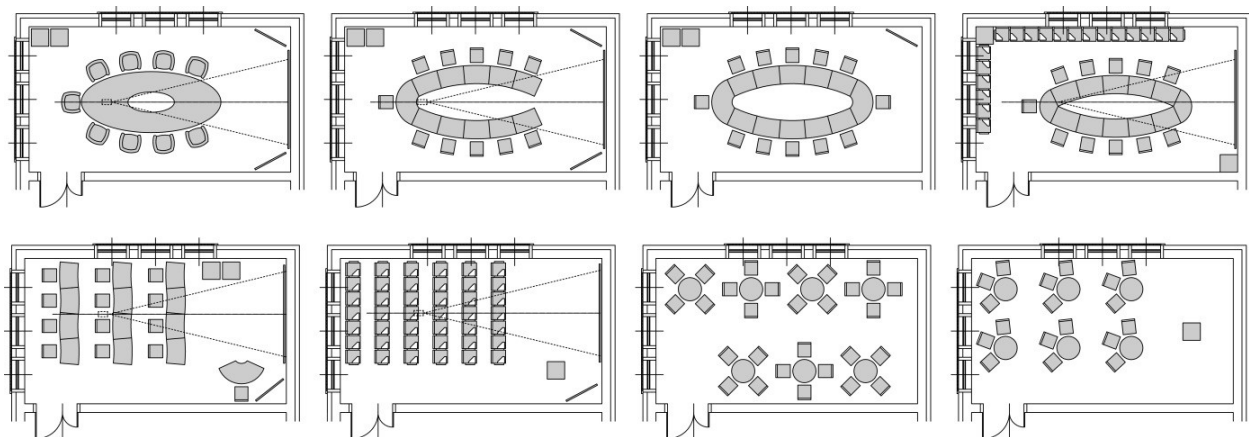


Fig. 8 Arrangements of minor conference halls- from left: boardroom, horse-shoe, elliptical, elliptical with audience, classroom, auditorium, banquet, cabaret-type (drawings made in 2012)

Acoustics and visibility

Acoustics in public spaces is a combination of two factors. The first one is connected to the structure of building compartments – exterior and interior – and their isolation from airborne and material sounds. The second is the architectural acoustics of rooms, determined by their shape and materials. Although electroacoustic systems are usually used for both small and large conference rooms, it is important that optimal natural parameters be provided

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for these halls. Otherwise, even the most sophisticated system of microphones and loudspeakers will not be fully functional. As far as room sound isolation is concerned, different systems are taken into account. The most popular has massive walls on the outside with the thermal insulation also functioning as sound insulation. For interiors, multi-layered light walls are used, with mineral wool usually serving as an absorber. Floors and ceilings are also built of acoustical layers. In order to ensure proper functioning of the aforementioned solutions, all building details and joints must be designed and implemented carefully so that sound is not propagated through the so-called “weak points” of the structure. Windows and doors must also be optimal for sound transmittance and they must be perfectly embedded into the wall. In large halls, acoustical vestibules can be added, with floors, walls and ceilings covered with absorbent materials, and with double doors to provide external sound transmittance.

Architectural acoustics must take into account several factors. The sound heard in the interior is a sum of the directional sound and the first lateral reflection, which inform about the type, character and position of the sound source. Although they are very helpful in creating the ambience of the room, higher reflections can cause distortion and illegibility of speech, so at some points they must be muted. Human voice is much weaker than any instrument and it needs a shorter reverberation time (1,5 s) than in traditional music halls (1,8–2,2 s). Since reverberation time is, among others, the derivative of volume, this is one of the causes why large assembly halls lose sound quality if they are designed as multifunctional halls. In terms of cubature of rooms dedicated only for speech, Chmielewski (Chmielewski, 2010) recommends 4-7 m³ of volume per person, with maximum number of 1700 attendees. What is more, the human voice is directional, and it will be best heard at angles of +55° and –55° relative to the line along the middle of the face in the case of a projection and approximately +30°, –30° in the case of a section (Kulowski, 2007), (Barron, 1993). This is why the speaker is enveloped with reflective materials and the rear walls in halls are usually covered with absorbent.

Whereas the front of the auditorium, ceiling and side walls should be shaped so as to reflect sounds towards the audience, the rear and the audience itself must absorb the late reflections and excess sound energy. In order to properly shape the acoustical field in smaller halls it is enough to use diffusing and absorbing panels, reflecting structures, absorbent upholstery and curtains, while in large halls one can use professional diffusers (i.e. band, Helmholtz), absorbing and reflecting systems, or full electro-acoustical systems. (see figure 10). Materials used for major rooms are strictly connected to acoustics. Reflecting surfaces include the following materials: hard stones, fiber-cement boards, plaster, and plywood (instead of wood, for fire safety reasons). Absorbent materials, on the other hand, are usually multi-layered, i.e. stone-wool can be hidden under a textile cover or perforated plywood panels. Although large halls rarely have access to natural light, glass is also frequently implemented, as it is an excellent reflecting material. Large assembly halls cannot be designed without professional acoustical documentation, which covers specialist issues, such as sound focusing shape – in the case of the popular circular and semi-circular layouts – or fluttering echo occurrence – in standard rooms with parallel walls.



Fig. 10 Acoustic solutions for conference space – on the left: ceiling with suspended acoustical panels, in the middle: vomitorium entrance with absorbent finishing, both at the plenary hall at “Cesar’s Palace” Hotel, Las Vegas, USA, on the right: a typical boardroom hall finishing in “Sofitel Chicago Water Tower”, USA (2013)

Interestingly enough, visibility is connected to direct sound. Usually, if a person can directly hear the sound source, e.g. the stage, speaker, or loudspeaker, they will also see them well. This is why tables in smaller halls are curved,

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which prevents guests from screening each other and in an auditorium, the audience area slopes upwards. In the last example, the recommended increase in angle for subsequent rows is based on the position of the eyes of a sitting man with respect to the floor, the distance between the eyes and the top of the head, and the position of a point that should be seen on the stage. Because these factors may vary, i.e. it is necessary to see the lower edge of the screen or the shoes of the speaker, the visibility must be individually adjusted. (see figure 11 and 12). However it seems popular for medium auditoriums, i.e. those which accommodate up to 1000 viewers, to use increments of 45 cm for all rows, which guarantees perfect visibility and comfortable height of steps in aisles. To enhance visibility, seats in subsequent rows can be additionally offset in the so-called “staggered” arrangement. It is also very important for the configuration of the auditorium to follow fire safety regulations, which may determine parameters of rows, aisles, and the number of seats. These requirements will vary over time and depending on the country.

CONCLUSIONS

Large hotel spaces should be integrally designed as a combination of streams of regular and evacuation movement of people, according to function, proper articulation of sound, visibility and physical and psychological needs of users. (see figure 11 and 12). Based on the presented considerations, a general plan and section were formulated, which contain designing guidelines for the main lobby, conference lobby, an small and large conference halls. The graphs show examples of movement streams, spatial plan connections, visibility angles and sight lines, propagation of direct sound and reflections (where waves are visualized as lines) and placement of reflecting, absorbing and mixed materials. They also include service areas, such as the reception and registration area an elevator lobby, the arrangement of seats and areas where people may scatter freely. In the graphical illustration of sound propagation, only one sound source was used.

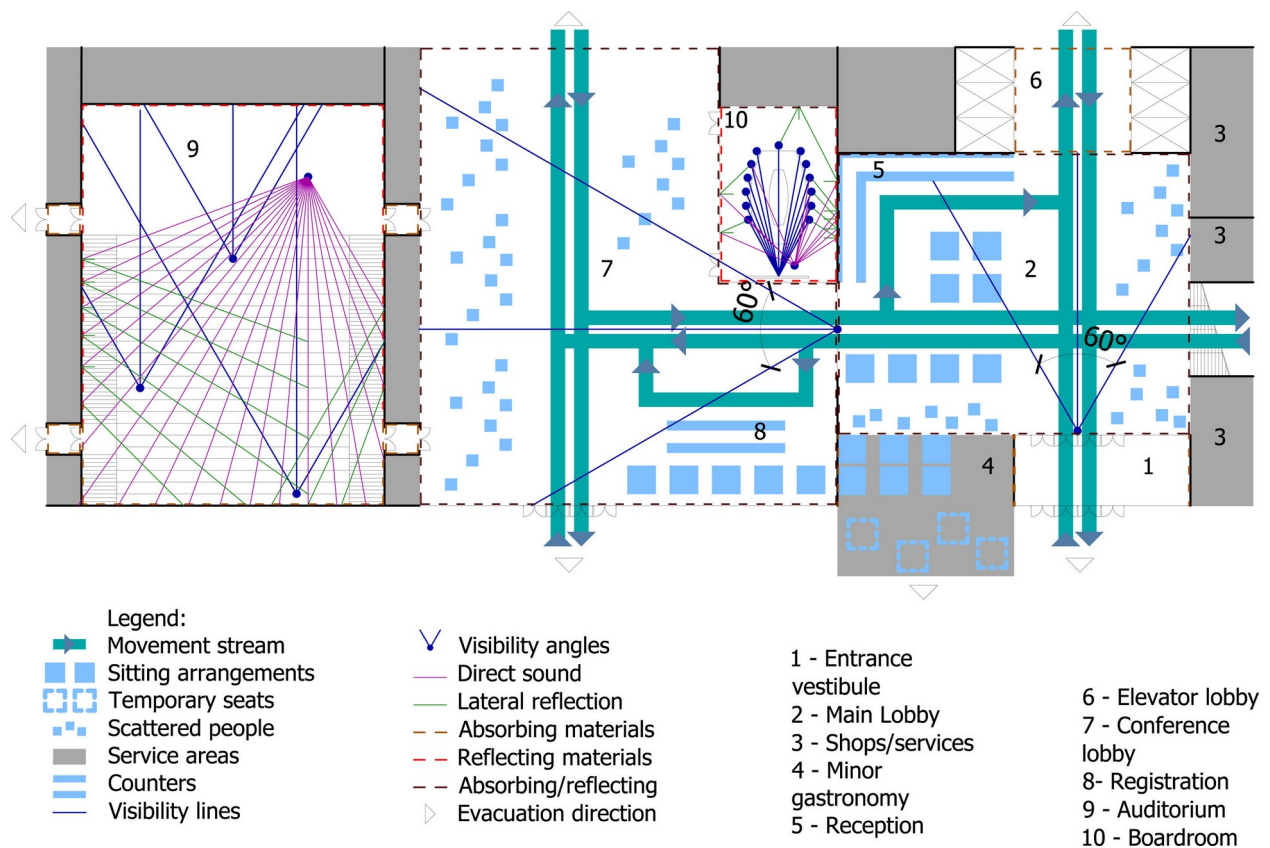


Fig. 11 General plan with design guidelines for movement circulation, evacuation, visibility and acoustics in large public spaces in hotels for (drawing made in 2014)

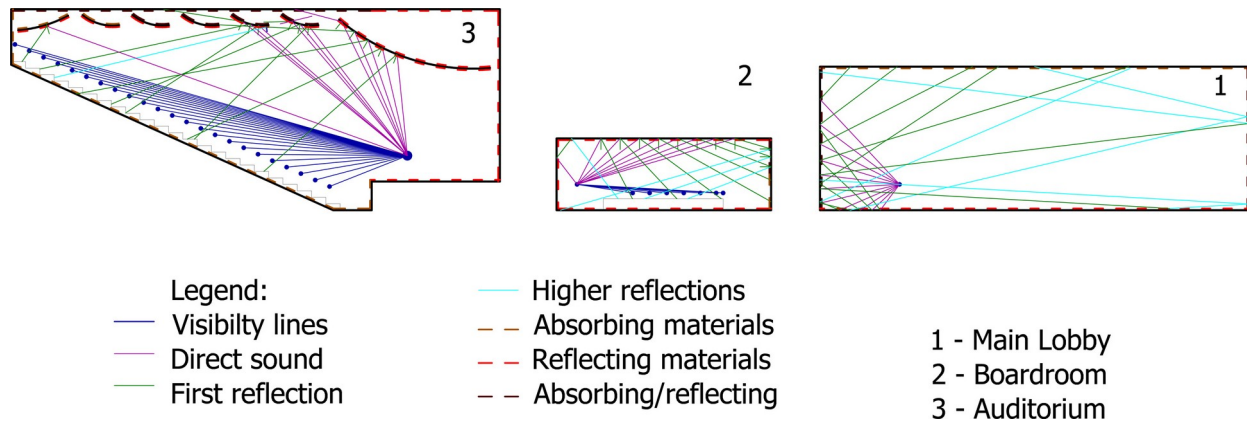


Fig. 12 General section with design guidelines for visibility and acoustics of large public spaces in hotels for (drawing made in 2014)

Although the schemes are estimates and each example of hotel space is different, they show general recommendations, which might be very helpful in designs aiming at better humanization of large hotel spaces. When planning all of the elements it is crucial to remember that all technical, structural, building and material solutions must also aim at creating optimal space with a distinct, individual character.

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