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MAINTAINING PRIVACY AS A RESIDENT IN A MIXED-USE BUILDING THROUGH ARCHITECTURAL MEANS

This article examines privacy challenges in mixed-use buildings, exploring solutions through case studies. It analyses sound insulation, spatial zoning, facade design, and security features, offering best practices for balancing community integration with personal privacy. Insights from successful implementations guide improvements for future projects.

***Keywords**: mixed-use building, privacy, residential complex, architectural design, acoustic isolation.*

Statement of the problem

Mixed-use buildings have become increasingly popular in urban areas, blending residential, commercial, and sometimes even industrial spaces within a single development. While they offer convenience and economic benefits, one of the primary concerns for residents is privacy. The close proximity of different functions—such as retail stores, offices, and entertainment spaces—can lead to noise pollution, visual intrusion, and a lack of personal security.

One of the challenges to privacy in a mixed-use building is the noise pollution. Commercial spaces generate noise from customers, deliveries, and mechanical systems that can disrupt residential areas. Offices may have extended working hours, leading to increased foot traffic and disturbances. Restaurants and bars often feature music, social gatherings, and late-night activities, further exacerbating noise concerns. Street noise, including vehicle traffic, honking, and outdoor events, can permeate residential spaces if proper sound insulation is not in place. Thin walls, uninsulated floors, and shared ceilings between units may amplify everyday sounds such as footsteps, conversations, and home appliances, leading to a lack of acoustic privacy.

Another challenge is about the security. Common entries and common areas can present a security hazard by allowing free movement between residential and commercial zones. The increased foot traffic of non-residents, including shoppers, employees, and visitors, may increase the risk of intrusion into private residential areas. Unsecured entryways with insufficient surveillance could allow for easy access to a secured area for a trespasser or someone intending harm. Poorly constructed parking spaces and back doorways can pose prime opportunities for easily accessed entryways by unauthorized guests while remaining unobtrusive.

That is why providing privacy for residents of multifunctional formations requires a well-structured security strategy. Controlled access points, surveillance systems, and clear zoning separations can help mitigate risks. Implementing key card systems, secure lobby designs, and designated residential-only areas ensures a balance between accessibility and safety. Thoughtful architectural planning should integrate these measures without compromising the openness and functionality of shared spaces.

Analysis of recent research and publications

Several theoretical works on multifunctional buildings describe important aspects that form the basis of present study.

Geoff Craighead, in the article entitled "Mixed-Use Buildings" [1], brings into focus on fire safety and security of mixed-use structures being built in high-rise configuration. It talks about privacy versus entry control using key cards through restricted residential zones and monitoring, zoning on the basis of designing different residential blocks to minimize public intrusion into housing areas, and noise reduction through the direct implementation of fire and safety policies on restricting any noise disruption from other activities going in the building, thereby protecting privacy.

The article "A Study of the Sources of Noise Pollution and Their Impacts on the Built Environment"[2] investigates noise pollution at Oba-Ile Housing Estate, Nigeria. Some sources of noise pollution identified are traffic, religious activities, and household devices. It recommends the need for better building designs, strategic setbacks, optimized openings, and promulgation of noise regulation to ameliorate living conditions.

The article "Managing Acoustics in Mixed-Use Urban Developments"[3] by Ratio Seven discusses the challenge to control noise in urban buildings that mix residential, commercial, and public space. They also mention the need for efficient sound insulation and good structural design to lower noise pollution and ensure occupant comfort.

The study "Residential acoustic amenity in vibrant

mixed-use areas" [4] investigates the noise impacts between commercial and residential uses in mixed-use areas in New South Wales (NSW), highlighting the conflict between residential expectations for quietness and the need for vibrant commercial spaces. It shows that current planning policies in NSW and Sydney do not adequately address these issues, suggesting that there is a need to find better noise control strategies if one wishes to strike a balance between residential amenity and commercial vibrancy, especially in urban areas with high density. The study emphasizes understanding the expectations, both of residents and of business operators, with respect to that acoustic quality.

Recent studies highlight the need for privacy by the good management of zoning, security, and acoustics in multifunctional buildings. However, there is a gap between research on environmental aspects, such as noise control, and architectural design strategies for integrating these elements. Bridging this gap with comprehensive methodologies can enhance privacy, safety, and acoustic comfort, ensuring balanced environments for both residents and businesses in high-density, mixed-use spaces.

Formulation of the goal of the article

The principal aim of the research herein presented was that of studying the interrelation between zoning, security, and acoustics in multifunctional buildings and how these factors influence privacy in high-density, mixed-use contexts. This implies addressing the issues arising from noise pollution and security threats in public spaces. The study is intended to knit together environmental studies and architectural hypotheses so that the attributes that enhance both residents and facilities constitutively would be accommodated in urban projects.

To achieve this, the following tasks were set for research:

1. Explore the effective design strategies to deal with zoning, security, and acoustics to enhance privacy in mixed-use buildings on the basis of case study.

2. Analyze how these strategies influence the balance between residential comfort and commercial activity.

Presentation of the main material

A detailed analysis of the main material relevant to maintaining privacy in mixed-use buildings allowed authors to highlight architectural strategies addressing zoning, security, and acoustics – three critical aspects for ensuring privacy for residential occupants in these multifunctional environments.

Zoning and Spatial Separation: Effective zoning within mixed-use developments is essential for minimizing the intrusion of commercial or public activities into residential spaces. Well-defined boundaries, both physical and visual, are necessary to create a distinct separation between different functional areas. For instance, elevating residential areas above commercial zones or using intermediate floors that house noise-dampening functions like mechanical systems can provide an additional layer of privacy. In addition, layout planning can direct foot traffic away from residential zones, reducing disturbances caused by increased public presence.

Case Study: The Barbican Estate [5], London, UK The Barbican Estate is a iconic mixed-use development in London that combines residential, commercial, and cultural spaces. It is known for its innovative design, which carefully separates residential areas from public and commercial zones to ensure privacy for residents.

Residential towers (Fig.1) are elevated above ground-level commercial and cultural spaces, such as theatres and galleries. This vertical separation ensures that residents are insulated from the noise and activity of public areas.

Fig. 1 – Residential towers of The Barbican Estate (image by Riodamascus [6])

Buffer Zones: The Barbican uses landscaped courtyards and green spaces as buffer zones between residential and public areas. These spaces act as natural sound barriers and provide visual privacy for residents.

Separate entrances and pathways are designed for residents and visitors. Residential areas are accessed through secure lobbies, while public and commercial spaces have their own entrances, ensuring that foot traffic does not intrude on private residential zones.

The design of the Barbican includes architectural screens, such as concrete walls and balconies, that create visual barriers between residential units and public spaces. This ensures that residents are not exposed to unwanted views or disturbances.

Security Design Considerations: Security features are integral to maintaining privacy, particularly in areas with high public access. Implementing controlled access systems, such as key card entries or biometric access, can prevent unauthorized individuals from entering residential areas.

Surveillance cameras, well-lit pathways, and secure elevator systems can also improve safety and help to monitor the movement of people within the building. Thoughtful placement of common spaces, such as placing commercial entrances away from residential entrances, can further mitigate privacy concerns.

Acoustic Solutions and Sound Insulation: Soundproofing is perhaps the most pressing issue in mixed-use buildings, where noise pollution from surrounding commercial, retail, and entertainment spaces can interfere with residents' comfort and privacy. High-quality insulation materials in walls, ceilings, and floors can greatly reduce noise transmission. In particular, strategies like double-glazed windows, acoustic barriers, and the integration of quiet zones within buildings can help manage noise levels. Additionally, strategic setbacks and building facades designed to absorb or reflect sound can protect the acoustic integrity of residential spaces.

Recent studies have highlighted the positive outcomes of combining these architectural strategies, showing that thoughtful planning and design can significantly mitigate privacy concerns in mixed-use buildings.

In their article "What is Functional Mix? An Assemblage Approach"[7]. Dovey and Pafka (2017) explore the concept of functional mix within urban and architectural contexts, emphasizing how different activities and spaces interact within a single development [5]. Their tool, the live/work/visit triangle, provides useful insights that can enhance our understanding of how zoning and spatial separation can improve privacy in mixed-use buildings (Fig. 2).

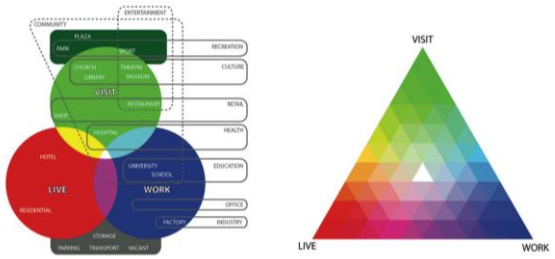


Fig. 2 – Overlapping functions (left) and the Live/Work/Visit Triangle (right) (adapted from Hoek (2006) [8])

The typology of mixed-use buildings can be categorized into distinct patterns based on the integration and spatial organization of living, working, and visiting functions. These typologies define how different activities coexist within a single structure, influencing circulation strategies, privacy levels, and urban interactions.

Type A follows the traditional "shop-top" model, a widely recognized pattern where commercial spaces, typically retail, are located at the street level, while residential units are placed above with segregated access to maintain privacy and separation between uses.

Type B introduces a more interconnected network by incorporating mixed work and visit functions through multiple street entries and arcades, yet still maintains a distinct separation by placing residential units within a dedicated tower.

Type C represents a more blended approach, where all three functions—live, work, and visit—are mixed at the street level, but the combination gradually transitions towards a primarily residential character on the upper floors. This typology is structured around a circulation spine that deepens into the building, allowing for a layered integration of activities.

Type D takes this integration further by extending live/work functions deeper into the building footprint, while still reserving the uppermost floors exclusively for residential purposes. It is also characterized by active street-side commercial elements, ensuring engagement with the urban fabric while maintaining a balance between public and private spaces.

Type E represents the most integrated and complex typology, where the mix of work and visit functions is distributed throughout the lower levels, and live/work functions extend vertically across the building's depth, creating a fully intertwined environment. This typology fosters a high level of interaction between different users, promoting a dynamic and flexible use of space. Together, these typologies illustrate the diverse approaches to multifunctional buildings, demonstrating how different configurations can accommodate urban density, enhance accessibility, and influence the experience of both residents and visitors within mixed-use environments (Fig. 3).

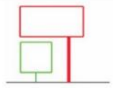
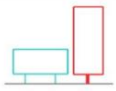
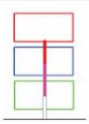
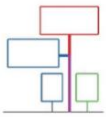
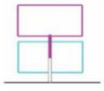
TYPE	DIAGRAM	PATTERN	EXAMPLES
A LIVE + VISIT		This is the pattern that is generally known as 'shop-top' housing with retail at street level and segregated entries.	PL3, PL4, PL5 SP5
B LIVE + WORK & VISIT		This type incorporates a network of mixed work/visit functions accessed through multiple street entries and arcades with a separated residential tower.	SP1 HC2
C LIVE + WORK + VISIT		Here all three functions are mixed at street level access, but this mix is reduced to live/work and then to residential for the upper floors, as the circulation spine progresses deeper into the building.	PL1, PL2 HC1, HC4
D LIVE + LIVE / WORK + WORK / VISIT		In this type live/work functions penetrate deeply into the building while reserving upper floors as residential; It is augmented with street-sides shops and work functions. This pattern forms a majority of examples from the Semi-Planned area.	SP2, SP3, SP4 HC3
E LIVE & WORK + WORK & VISIT		While there is only one example, this is the most mixed example and the only one where mixed access extends throughout the depth of the building which is characterized by a mix of work and visit on lower floors with a mix of live and work above.	HC5

Fig. 3 – A typology of mixed-use buildings (scheme for the city of Dhaka, from [9])

In order to enhance privacy and ensure a balanced environment within mixed-use buildings, it is crucial to consider the interrelationships between the three primary functions—live, work, and visit. This relationship can be conceptualized using the live/work/visit triangle, a framework developed by Dovey and Pafka (2017) that addresses how residential, commercial, and public spaces can coexist in a way that respects privacy while encouraging interaction and activity [5].

Zoning and Spatial Separation through the Live/Work/Visit Triangle:

The live/work/visit triangle offers a valuable approach to understanding how spatial and functional boundaries can be defined and organized within mixed-use developments. Each of the three components—live (residential), work (commercial/office), and visit (public spaces)—represents a distinct area of the building that often has conflicting needs in terms of privacy, noise, and foot traffic.

Live: Residential spaces are the core of the triangle and need to be designed with privacy and comfort in mind. The proximity to noisy commercial areas and public spaces can disrupt this comfort, making spatial separation a critical design principle. The live function requires insulation from external disturbances, both acoustic and visual. Elevating residential areas above commercial zones or creating intermediate buffer zones, such as mechanical floors or service areas, can help ensure a quiet and private residential environment. Furthermore, the spatial layout should direct foot traffic away from residential units to minimize disruptions from the public and commercial activities.

Work: Commercial and office spaces form the work component of the triangle. These areas are often in operation during business hours and can generate noise, traffic, and visual distractions. Proper zoning is essential to ensure that these functions do not intrude on the residential areas. For example, placing office spaces below or at a distance from residential units, or using sound-dampening materials between floors, can prevent noise from seeping into the living areas. Additionally, commercial spaces should be accessed from distinct entrances, separate from those of the residential areas, reducing the chance of non-residents intruding into private spaces.

Visit: The visit function includes public spaces such as retail areas, restaurants, and cafes. These spaces often draw transient visitors, which can lead to security risks and disturbances for residents. Therefore, ensuring that these areas are visually and physically separated from residential units is key. Zoning should focus on directing public traffic away from areas where residents live. For example, placing public amenities on the ground floors, or along one side of the building, helps to keep them distanced from private residential spaces. In addition, implementing access control measures, such as restricted entryways to the residential floors, can further secure the boundary between public and private functions.

Balancing Residential Comfort with Commercial Activity: The live/work/visit triangle directly addresses the balance between the residential and commercial/public functions. By creating well-defined boundaries between these areas, privacy for residents can be maintained while still allowing for vibrant commercial and public spaces.

Acoustic and Security Buffers: The live function needs to be protected from the work and visit components in both visual and acoustic terms. As mentioned, this can be achieved by strategic zoning and design interventions such as soundproofing, the use of buffer zones (e.g., mechanical rooms or storage areas), and the careful placement of common areas like elevators and stairwells. The work and visit functions, while vital to the mixed-use nature of the building, should be designed to minimize their impact on the residential units.

Case Study: One Central Park [10], Sydney, Australia.

One Central Park (Fig.4) is a mixed-use development in Sydney that combines residential, commercial, and public spaces. The building is known for its innovative design, which includes extensive greenery and advanced acoustic solutions to ensure privacy and comfort for residents.

Fig. 4 – One Central Park, Sydney, Australia
(image by Murray Fredericks [11])

The walls, floors, and ceilings of One Central Park are constructed with high-quality soundproofing materials to minimize noise transmission between different functional areas.

Residential units are equipped with double-glazed windows that provide excellent sound insulation, protecting residents from external noise sources such as traffic and public gatherings.

The building features specialized acoustic panels and thick walls that act as sound barriers, reducing the impact of noise from commercial and public spaces.

The building's facade is designed to absorb and reflect sound waves, reducing the amount of noise that reaches residential units. The use of greenery on the facade also helps to dampen sound.

One Central Park includes designated quiet zones, such as landscaped courtyards and green roofs, where noise is minimized. These areas provide residents with peaceful outdoor spaces away from the hustle and bustle of the city.

Foot Traffic Management: Another way the triangle influences design is through the management of foot traffic. The layout can be adjusted so that movement between commercial and residential areas is directed away from residential units, reducing the potential for disturbances. For example, entrances to retail spaces should be located away from residential entrances, while common areas can be located on intermediate floors, ensuring that public movement does not intrude into private residential spaces.

Visual and Spatial Privacy: The live/work/visit triangle also serves as a guiding principle for maintaining visual and spatial privacy. For example, residential units can be designed with privacy-enhancing features such as balconies or setbacks that ensure they are visually isolated from busy commercial or public spaces. Additionally, residential windows can be oriented away from high-traffic areas or public spaces, and the building's façade can include elements that protect privacy, such as louvres or green walls.

Integrating the Triangle into Mixed-Use Design: Incorporating the live/work/visit triangle in the design and planning of mixed-use buildings helps address the conflicting needs of these three functions, allowing for a coherent strategy that respects the privacy of residents while enabling the vibrancy of commercial and public spaces. By carefully defining the boundaries of each function and using architectural solutions to manage their interactions, architects can create environments where both residential comfort and commercial activity thrive in harmony.

Landscape and buffer zones: Landscape integration and buffer zones play a crucial role in maintaining residential privacy in mixed-use complexes by creating natural and aesthetically pleasing barriers between different functional areas (fig 5). Strategically placed green buffers, such as dense hedges, vertical gardens, and courtyard plantations, serve as both visual and acoustic shields, minimizing exposure to adjacent commercial and public spaces. Layered vegetation of varying heights enhances privacy by filtering views while softening the built environment. Additionally, water features and green roofs provide secluded outdoor spaces for residents, reducing noise pollution and fostering a sense of tranquility. These landscape solutions not only improve privacy but also contribute to environmental sustainability by supporting biodiversity and enhancing microclimates. By combining greenery with structural elements like fences or walls, architects can create buffer zones that balance seclusion with openness, offering residents a peaceful refuge within vibrant mixed-use environments.

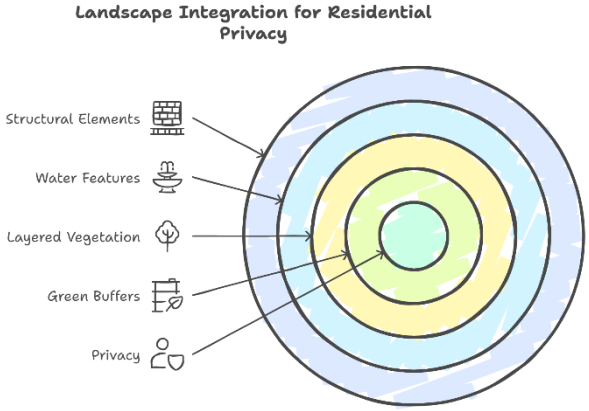


Fig. 5 – Landscape integration for privacy (own work)

Case Study: The Interlace [12], Singapore The Interlace is a mixed-use residential development in Singapore that combines apartments with commercial and public spaces. The building is designed to provide a quiet and private living environment for residents, despite its location in a densely populated urban area.

The Interlace features extensive landscaping, (Fig. 6) including courtyards, gardens, and green walls, that act as natural barriers between residential units and commercial spaces. These *green buffers* reduce noise and visual intrusion, ensuring privacy for residents.

Fig. 6 – Landscape features in The Interlace (image by Iwan Baan [13]).

The landscaping includes plants of varying heights and densities, creating multi-layered green zones that filter views and absorb sound. This layered approach enhances both visual and acoustic privacy.

Reflective pools and *water features* are integrated into the design, providing additional noise reduction and creating tranquil outdoor spaces for residents. These features also contribute to the building's aesthetic appeal.

The building includes rooftop gardens and terraces that offer secluded outdoor spaces for residents, away

from the noise of the city. These green roofs also help to insulate the building, reducing energy consumption.

The design combines greenery with architectural screens and walls to create buffer zones that balance seclusion with openness. These structural elements ensure that residents can enjoy privacy while still feeling connected to the surrounding environment.

Technological Solutions: Technological solutions (Fig.7), such as smart glass and automated shading systems, offer dynamic control over visual exposure. Smart glass can transition from transparent to opaque, granting residents control over privacy levels. Automated shading systems can be programmed to adjust based on sunlight or occupancy, ensuring consistent privacy without manual intervention.

Sound masking systems, which generate ambient background noise, can further improve acoustic privacy in residential units. Additionally, home automation systems that control lighting, blinds, and sound systems allow residents to customize their environment according to their privacy needs. The integration of biometric access control systems enhances security, ensuring that only authorized individuals can access residential zones.

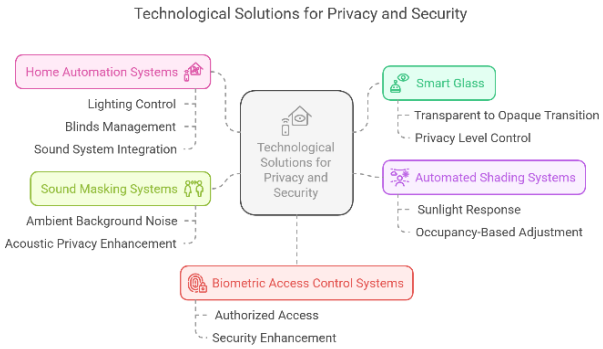


Fig. 7 – Technological solutions for privacy and security (own work)

Case Study: Bosco Verticale [14], Milan, Italy Bosco Verticale, or "Vertical Forest," is a pair of residential towers in Milan that incorporate extensive greenery and advanced technological solutions to enhance privacy for residents. The buildings are surrounded by commercial and public spaces, making privacy a critical concern.

Residential units are equipped with *smart glass* windows that can transition from transparent to opaque. This allows residents to control their level of visual privacy, blocking views from the outside when needed.

The building features *automated blinds* that adjust based on sunlight and occupancy. These systems ensure consistent privacy without requiring manual intervention from residents.

Bosco Verticale uses sound masking systems in residential areas to generate ambient background noise. This helps to mask unwanted sounds from commercial and public spaces, improving acoustic privacy.

Residents can control lighting, blinds, and sound systems through a centralized home automation system. This allows them to customize their environment according to their privacy needs.

The building uses biometric access control systems, such as fingerprint scanners and facial recognition, to restrict access to residential areas. This ensures that only authorized individuals can enter, enhancing security and privacy.

Conclusions

Maintaining privacy in mixed utilized buildings is a complex architectural challenge that requires zoning, security measures and strategic integration of acoustic solutions. This study has highlighted that spatial separation, controlled access, sound insulation and landscape integration can create an environment that balances the benefits of multi -ribbed buildings, and preserves privacy.

Analysis of case study and theoretical research emphasizes the importance of clear functional regulation, where different boundaries between housing, commercial and public areas are necessary to reduce disorders. Security measures, such as key card systems, monitoring and controlled access points, play an important role in reducing the risk associated with shared places. Meanwhile, sound insulation and acoustic solutions, including technological innovations such as smart glass and automatic shading, are practical methods to increase privacy.

Live/Work/Visit Triangle Framework provides valuable insight into interaction between different building functions and can be adapted for privacy without compromising urban vividness. In addition, the greenery and buffer zones are effective in improving both visually and acoustic privacy, and shows that natural elements can serve as both functional and beautiful barriers.

While these strategies provide viable solutions, the study also identifies gaps in today's architectural and urban planning practices, especially in the integration of environmental factors such as noise control into general design approaches. Future research should focus on developing comprehensive functional schemes which include these elements in the plan for high density buildings of mixed use.

By implementing thoughtful architectural strategies and embracing technological advances, the development of mixed-use buildings can provide residents with privacy while maintaining the dynamic, communal form of urban life. Ultimately, a well-balanced approach will contribute to long-lasting success and stability on the mixed-use program, and ensure that it remains both active and lively.

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ЗБЕРЕЖЕННЯ ПРИВАТНОСТІ ДЛЯ МЕШКАНЦІВ БАГАТОФУНКЦІОНАЛЬНОЇ БУДІВЛІ ЗА ДОПОМОГОЮ АРХІТЕКТУРНИХ ЗАСОБІВ

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Стаття містить дослідження архітектурних викликів, пов'язаних із забезпеченням приватності у багатофункціональних будівлях, де житлові, комерційні та громадські функції мають гармонійно співіснувати в межах однієї структури. У міру зростання щільності міських районів потреба в ретельно спроєктованих змішаних забудовах стає все більш актуальною, що піднімає важливі питання щодо збереження приватності мешканців при одночасному сприянні громадській взаємодії. У дослідженні аналізуються можливі рішення на базі детального розгляду вдалих зразків багатофункціональних житлових споруд, а також академічних праць, які висвітлюють успішні приклади, надаючи всебічне розуміння того, як архітектори та міські планувальники вирішують ці проблеми у реальних проєктах.

Досліджуючи широкий спектр проєктних підходів, стаття виокремлює кілька ключових стратегій покращення приватності у змішаних забудовах. До них належать вдосконалені звукоізоляційні технології, які допомагають мінімізувати поширення шуму між різними функціональними зонами, забезпечуючи мешканцям комфорт і захист від шуму комерційної чи громадської активності. Крім того, розглядаються методи

просторового зонування, які є ключовими для управління приватністю, адже правильне планування дозволяє створювати чіткі межі між публічними, напівприватними та приватними зонами. Інноваційний дизайн фасадів також відіграє важливу роль у забезпеченні візуальної приватності – такі елементи, як жалюзі, перфоровані панелі, тоноване скло та зелені екрани дозволяють ефективно регулювати оглядові можливості без шкоди для природного освітлення та вентиляції. Крім того, у статті розглядаються покращені системи безпеки, включаючи контрольовані точки доступу, розумні системи відеоспостереження та біометричні технології входу, що забезпечують захист житлових приміщень від несанкціонованого проникнення, водночас сприяючи безперешкодному функціонуванню комерційних і громадських просторів.

Окрім архітектурних та технологічних рішень, стаття також аналізує роль принципів міського планування у створенні умов для приватності у змішаних забудовах. Інтеграція зелених зон, буферних просторів та перехідних зон між різними функціональними секціями розглядається як спосіб мінімізації конфліктів між мешканцями та відвідувачами, що сприяє підвищенню загальної якості життя. Дослідження також вивчає вплив нормативних актів та будівельних стандартів на реалізацію заходів із забезпечення приватності, визначаючи правові рамки, які керують архітекторами та девелоперами у створенні добре спроєктованих, функціональних середовищ.

Оцінюючи практичне застосування цих рішень, стаття критично аналізує їхню ефективність, визначаючи сфери, де сучасні проєкти досягли успіху, а також напрями подальшого вдосконалення. Крім того, дослідження розглядає новітні архітектурні технології та матеріальні інновації, такі як адаптивні фасади, вдосконалена акустична ізоляція та модульні просторові конфігурації, що можуть значно покращити приватність у майбутніх проєктах. Ці висновки сприяють подальшому розвитку дискусії про те, як проєктувати багатофункціональні будівлі, що забезпечують оптимальний баланс між приватністю та відкритістю, гарантують комфортність життя, ефективність та адаптивність міського середовища до сучасних суспільних викликів.

***Ключові слова**: багатофункціональна будівля, приватність, житловий комплекс, архітектурне проектування, акустична ізоляція.*