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II

DOMESTIC DEVICES

HOW INTERIOR ARCHITECTURE AND DESIGN REACT TO THE CONTEMPORARY SCENARIO

Post-Domestic Ageing. Living Indoors (Without) Looking Outside?

Architectural Design and IT Devices for a New "Ageing in Place"

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Abstract
Ageing in place, in a domestic environment rather than in an institution, is people's preference in an ageing planet. This raises *post-domestic* design challenges as the home becomes now also a place for care, and most dwellings are not prepared to respond to the growing needs of fragile older people. In this paper we will explore the importance of architectural layouts, strategies, and the incorporation of IT technology for *smart homes*, as possible answers to these new requirements.
The importance of *façade depth* as a new design strategy for *lookout spaces* will be discussed in terms of the specific requirements of older residents who are *homebound* for health reasons or safety rules (as pandemic requirements), thus becoming places for a healthy connection with the outside world.
Homebound interior design also requires a new approach: *COVID-19* pandemic accelerated the new preference of working from home, no matter the age. New residential spaces are no longer exclusively domestic, and they require IT tech support for different activities. Flexibility of spaces is now a basic requirement: quickly changing or adapting domestic spaces with minor investments under a *life-cycle design* logic, keeping them safe for all, from grandchildren to grandparents, must become a ground rule for the future.
In this paper we will review recent findings on how the *post-domestic space* must be designed to host a comfortable and *active ageing* for senior citizens who choose to *age in place*.

1. Introduction

The ageing of population is a global phenomenon posing new challenges to the architectural design of housing, which will be approached in this article as a Post-Domestic habitat, in the sense of home spaces used and perceived in the later years of life according to new needs and fragilities (WHO, 2017). So, we will focus on some architectural issues related to people who choose to remain in their homes, either enjoying their retirement or embracing a new professional cycle of working from home (the *Generation M* of post-retirement workers) considering that "people in mid-life today can look forward to about 30 years of active life and the country needs this pool of skills, talents and experiences" (Hanson, 2002).

We will address Post-Domestic Habitat from the point of view of environments to *age in place* even though the concept itself is debatable (Forsyth & Molinsky, 2021) considering that different people and institutions have different understandings of what it means and what could or should be done to support it or enhance it. The World Health Organization defines ageing in place as "the ability of older people to live in their own home and community safely, independently, and comfortably, regardless of age, income or level of intrinsic capacity" (WHO, 2015, p. 36) so we may as well consider it a Post-Domestic Habitat in the sense of a new phase when supportive care and other needs of later life must be incorporated into the previous habitat, therefore adding a post condition to home.

2. *Smart Homes*

One of the biggest concerns of older people living alone is safety and security. In that sense, *Smart Homes* as spaces

equipped with AI-enabled IT technologies (Dong et al., 2023) can provide safe and secure living environments: surveillance systems and sensors can detect falls or other emergencies and immediately alert to ensure timely assistance to older people living alone, who can feel safer knowing that help is readily available when needed (Cao et al., 2022).
These assistive technologies can be incorporated on newly built housing as part of the whole infrastructure system or added later to existing spaces when necessary. In either case, architectural design is always of paramount importance to coordinate the discrete incorporation of the IT technologies (to avoid being rejected) and assure the final domestic quality, the privacy and the psychological comfort of home which older people value the most (Fischer et al., 2014).

Maintaining independence and autonomy is essential for *active ageing* (Bitterman & Shach-Pinsly, 2015) and *Smart Homes* can be designed to support and enhance independent living for older adults (Dermody et al., 2021).

Figure 1. Older woman at home interacting with ElliQ robot (Tianqin Chen d'après Intuition Robotics, 2023).

For example, *voice-first ambient interface* (VFAI) can control various aspects of the home, such as lighting, temperature, and appliances, helping older adults to perform daily tasks and enhancing their sense of self-sufficiency (Cuadra et al., 2023). In addition, AI *virtual assistants* can provide reminders for medications, appointments, and other important tasks (Fig. 1), thereby reducing the need for human supervision or assistance.

In terms of physical and mental health, *Smart Homes* can also help: monitoring systems can continuously track vital signs such as heart rate and blood pressure and alert healthcare professionals in case of any abnormalities while maintaining the resident's quality of life (Reeder et al., 2013; Bitterman, 2015). On the other hand, AI-virtual coaches can provide personalized workout habits and dietary advice to promote physical activity and healthy eating habits and *AI social companion* robots can also provide companionship and engage in conversations to reduce loneliness. Additionally, the design of *Smart Homes* can incorporate control of natural lighting, proper ventilation, and acoustics (architectural design decisions already common in *domotics design*), which have proven to positively impact mental and emotional health.
It can be argued or expected that these different options of AI-enabled IT technologies may still be estranged by most older people today, requiring their training and even participation in the design process of user-centred *assistive technologies* (Cao et al., 2022). But ageing is by definition a future-driven process (we all get older in the future, not in the past), meaning that what may seem awkward today can be naturally embraced in some years by the *digital generations*.

Recently, during the Covid-19 confinement, policies aimed at reducing coronavirus disease hospitalization and mortality rates, encouraged older adults to avoid social and physical contact (Di Gessa et al., 2023). This resulted in social isolation and increased loneliness for older adults, especially for the ones who live independently in their houses or apartments. And yet, during those Covid years, the easy access to video calls (something unthinkable a decade ago) proved to help alleviating this isolation and improve social connections (Kumar & Chawda, 2020) by offering remote contact with family, friends, and healthcare professionals. Therefore, the old home landline telephones which are being replaced by wireless phones, make it plausible that soon homes will be equipped with videoconferencing systems, in a *Smart Home* trend, contributing to reduce social isolation, especially among older adults (Pedersen et al., 2018).

But even though, IT technology used in *Smart Homes* brings a range of conveniences, there are also some negative issues. Findings suggest that older participants prefer to use *AI-assistants* for selective, non-essential features and functions, such as music, audiobooks, news, weather, games, and joke-telling, or simply in turning on the room lights without considering the use of *AI* devices essential for *ageing in place* (Orlofsky & Wozniak, 2022). But if that is an individual option, more concerning is the fact that it has been found that the *Smart Home* technology industry has not paid enough attention to data security and privacy (Wilson et al., 2017), rising some red flags towards cybersecurity of smart devices (Al-Shaqi et al., 2016). These are essential issues that must be addressed to build users' confidence, considering that community-dwelling

older adults are still willing to adopt *Smart Home* technologies to support independence (Wilson et al., 2017). But the ethical implications of social robots as guardians and caregivers for older people are also debatable (Pedersen et al., 2018), thereby demanding increased share of information about *Smart Home* technology to promote awareness and discussion (Dermody et al., 2021). On the other hand, it will always be the architect's mission to design a domestic environment incorporating all these IT and AI devices in a friendly matter so that the older residents feel in a cosy and homey atmosphere, not in a spied and controlled environment, thus solving important ethical issues (Dorsten et al., 2009).

3. *Façade Depth* and the Importance of Balconies

Façades are usually considered in a 2D design approach, in terms of visual quality, for the image of the building, resulting in compositional design decisions. We would like to introduce the concept of *façade depth* instead, not as image but rather as space. Therefore, the depth of spaces that belong to the façade and create the threshold between inside and outside, are essential to be considered when dealing with the quality of daily living, especially for older residents who spend most of their time at home.

In that sense, the functional aspect of a balcony is found to be the most important factor among others such as semantic, perceptual, physical, environmental, and beauty. Other factors that contribute to residents' satisfaction with balconies include dimensions, use of plants, connection with the sky, peace and comfort, safety, function, and beauty (Karimi et al., 2020).

Figure 2. Deep balconies in residential building in Milan. (Photo: António Carvalho, 2023).

Figure 3. Old couple drinking coffee and chatting on their balcony. Image generated with the prompt "old couple drinking coffee and chat on their balcony", by Midjourney (Tianqin Chen, 2023).

It did make a whole difference during Covid-19 lockdowns (Fig. 2): having protruding balconies where to stay and get sun, fresh air, and talk or wave to neighbours from distance, or having a recessed balcony (loggia) where to seat protected in the shade, were rediscovered by residents in its potential as privately owned outside spaces, their safe connection (Fig. 3) to the external world (Ertas et al., 2022). Even from a safe distance, having the possibility of visually enjoying the outside environment, especially if surrounded by natural elements (trees, parks, water, animals) was a great psychological relief. In fact, outdoor spaces play a crucial role in enhancing physical and mental health, promoting social interactions, and building communities.

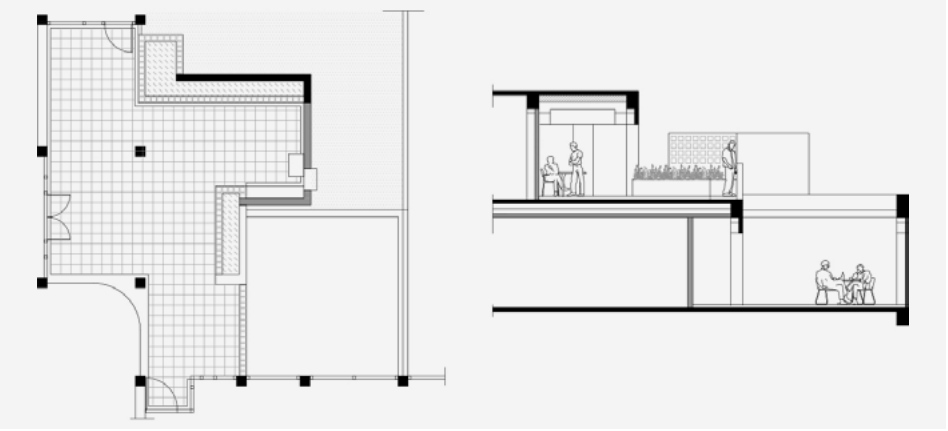

Figure 4. Herman Hertzberger, De Drie Hoven Housing, Amsterdam, 1971. Residents in clusters of apartments share terraces and interact with each other across different floors. (Redrawn by Tianqin Chen, 2023).

On this we may refer important case studies such as Herman Hertzberger's *De Drie Hoven Old People's Center*, from 1971, in Amsterdam, where each apartment was provided with an individual loggia and some clusters of apartments shared overlooking terraces to promote social interaction and fresh air (Fig. 4). Also, in 1989, Peter Zumthor, for his *Homes for Senior Citizens*, in Chur, Switzerland, besides creating a generous 3 meters-wide corridor-veranda as common access and social space for all residents, provided each apartment with one private loggia joining bedroom and living-room, as an alternative for private seclusion. MVRDV have also explored the use of balconies and terraces in several projects, from their expressive Elderly Housing *WoZoCo* in Amsterdam-Osdorp (1997) to the recent sculptural approaches of *Valley* in Amsterdam (2022) or the *Ascension Paysagère* in Rennes, France (2022), dealing with densification and high-rise, keeping balconies as protagonist elements for quality of living.

Besides, when it comes to façade design composition decisions, it is useful to remember that adequate natural light holds significance in regulating circadian rhythms, uplifting mood, and supporting overall well-being. And as *Post-Domestic spaces* also serve new purposes like working, studying, relaxing, entertaining, hygiene and cooking, the considerations of visual and thermal comfort and interior flexibility become paramount. Thus, creating suitable foreground shading conditions for windows using features like the balcony depth, shading devices, operable blinds, and vertical screens significantly shapes residents' perceptions of urban liveability. Condominium apartments design, for instance, should incorporate at least two elevations to ensure sufficient daylight for circadian rhythm adjustment and opportunities for cross-ventilation (Kesik et al., 2019).

During the Covid-19 pandemic, safety restrictions reshaped perceptions and use of indoor and outdoor spaces. Traditional gathering spots for older adults, like churches, senior centres, and gyms, became inaccessible or risky, underscoring the newfound importance of outdoor areas in daily life (Yan et al., 2021). Balconies and terraces, typically overlooked spaces, emerged then as alternative places for older individuals to spend time during lockdowns (Fig. 5). Balconies were transformed into essential communication hubs, fostering neighbourly interactions: there was a trend originated in Italy, where people held concerts on their balconies during the quarantine, demonstrating another purpose for balconies. Balconies, once viewed as mere extensions of living spaces, have now evolved into integral elements of well-being and social connection, providing a glimpse of hope and relief during challenging times.

Figure 5. Multi-family housing in Lisbon: deep balconies provide shaded spaces and fresh air for relaxing and enjoy the views to the public space. (Photo: António Carvalho, 2023).

Actually, a previous study on balcony usage already highlighted preferences for designs that included parapets and glass enclosures, which offered improved views, mood enhancement, and a sense of spaciousness (Xue et al., 2016).

The context of the Covid-19 pandemic also highlighted the correlation between higher temperatures, humidity, and accelerated virus transmission via airborne routes (Bate, 2020). Thus, addressing subpar thermal comfort in housing becomes critical from health, comfort, and well-being perspectives. A Toronto-based study revealed that occupants in buildings with more exterior glazing experienced greater thermal discomfort (Vakalis et al., 2019).

Balancing façade design and window-to-wall ratios is vital for year-round thermal comfort. Passive strategies such as natural ventilation and openable windows gain prominence, particularly due to scepticism about building ventilation systems amid the pandemic. Research demonstrates that open balconies contribute to improved thermal comfort, indoor air quality, sleep, and acoustic comfort (Ribeiro et al., 2020), while fully enclosed glazed balconies lead to overheating and restricted airflow.

The pandemic lockdown also sparked a trend in pro-nature design, as visual exposure to natural surroundings reduces anxiety and enhances mental well-being (Crosbie, 2020). Interaction with nature is increasingly recognized as restorative (Kaplan, 1995) prompting a rise in small-scale urban agriculture, known to bolster mental health (Makhno, 2020) and urban farming can thrive in spaces like sunrooms and balconies, facilitating engagement with nature (Nielsen, 2020). Therefore, home windows should be designed to offer unobstructed views of the sky and nature, linked to improved mental health, concentration, mood, satisfaction, and recovery.

Among other age groups, older people can benefit significantly from access to green areas, as these spaces encourage physical activity, counteract social isolation, and slow down functional decline (Bustamante et al., 2022). A survey of 6,000 participants from 77 countries found that people who had more contact with nature under strict lockdown were less likely to experience symptoms of depression and anxiety during a pandemic than those who had less contact with nature (Pouso et al., 2021). The value of connecting with nature, green landscapes, and outdoor

scenes is well-documented for stress reduction and cognitive improvement, with heightened significance during pandemics (Egerer et al., 2022; Mierzejewska et al., 2023). This also highlights the importance of private or condominium green spaces as green safe havens for residents during lockdowns, a factor to be considered in urban and residential design in the new *Post-Domestic* condition we are living in (Fig. 5).

4. The Need for *Flexible Design*

Most older people are not prepared to exchange their place of residence and it can be noted that their willingness to move is even lower as they grow older (WHO, 2017). When people look forward to *ageing in place*, they tend to focus more on the flexibility of the living space at home, which has become a fundamental requirement in interior design, especially in the context of a *life cycle design* logic (Birkbeck & Kruczkowski, 2015). Therefore, the ability to quickly change or adapt domestic spaces to ensure the safety of all, from grandchildren to grandparents, with a small investment (Di Gessa, Bordone, & Arpino, 2023), must become a basic rule for the future. Ageing is not static, it is an evolving process where people's lifestyles, abilities and requirements change in different phases of life, as they get older, and remaining in their homes comfortably and safely is an important challenge, also considering that older people are very diverse individuals with different capabilities, impairments, needs and preferences (WHO, 2007).

Flexible housing may be defined as housing that can adapt and change its pattern of functional answers, both to social and personal needs, to reach the standards of *lifelong housing*

(Cellucci & Sivo, 2015). The development of *flexible housing* is therefore essential throughout the life cycle, in a way that allows the occupants to change the layout to some extent, to live in their homes in various forms and without limiting the specific functions of the spaces, adapting them to the different needs of the family. This can be seen in *Zippers,* a project by LEVS Architects, 2017, for the city of Luxembourg: a modular wooden building system, able to be adjusted or disassembled and reused for future sustainability and living experiences (Fig. 6).

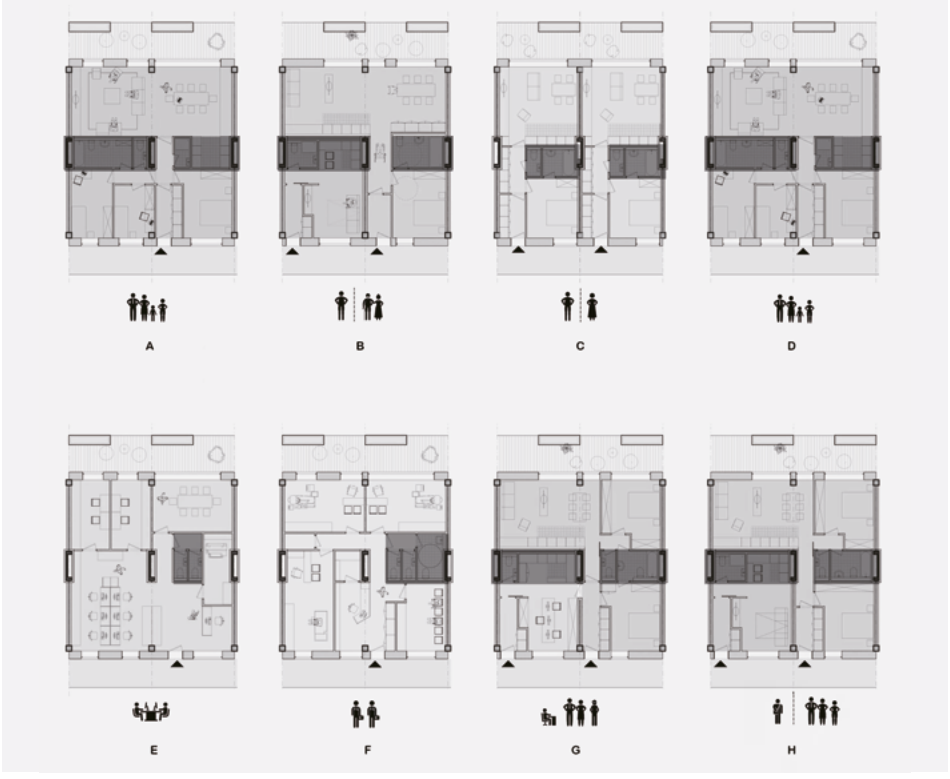

Figure 6. LEVS Architects, *Zippers*, Luxembourg: a clear modulation of the structure and water shafts allows the flexibility of not only subdividing apartments according to the life cycle of households (A, B, C, D), but also easy transformation into co-working (E), office spaces (F), home-office (G) or sub-letting (H), 2017. (Redrawn by Jingya Zhou, 2023).

A clear modulation of the structure and water shafts allows the flexibility of not only subdividing apartments according to the life cycle of households (A, B, C, D), but also easy transformation into co-working (E), office spaces (F), home-office (G) or sub-letting (H). In addition to the flexibility of living rooms turned into meeting rooms, dining tables turned into conference tables, kitchens and bathrooms ultimately designed according to universal design for use in the event of physical injury, and the versatility of bedrooms prepared for care support, the fluidity and ease of connectivity of all indoor spaces, as well as security, are essential needs for most people, especially in their later years of life. On the contrary, living spaces that do not correspond to the physical characteristics and needs of the users may create barriers to the full utilization of the room and in some cases may even become a real source of danger (Katarzyna et al., 2018), thus reinforcing the importance of the flexibility of the dwelling.

Spatial connectivity and mobility are essential for improving the quality of life of older adults, which involves creating spaces where they can move freely without constraints (Rantanen et al., 2021), that is being free and using their dwellings without encountering physical and functional barriers (Mahmood et al., 2022). Therefore, adopting universal design principles, open floor plans and flexible furniture in senior living spaces can help to create a seamless and adaptable environment (Zivkovic et al., 2021). Specifically, this can be achieved by removing steps, secondary walls, and using large windows and sliding doors to promote seamless connections between indoor and outdoor areas (Hosseini et al., 2015).

Figure 7. Traditional Japanese house: free circulation and open space system with sliding doors or folding walls, wide connection to outside nature (Source: Google images, 2023).

This creates inclusive environments where older people can maintain their independence and autonomy to engage in activities of daily living based on spatial mobility (Johnson et al., 2020). A reference could be the traditional Japanese house (Fig. 7) where spaces are organized by sliding doors in open layouts, both inside and outside, facing nature. To this end, ubiquitous accessible design should be integrated to ensure comfortable mobility for all residents in their daily lives (Sugiharto, 2017).

Improving safety of movements is thus essential, and special attention should be paid to the adaptation of rooms such as kitchens and bathrooms, as well as to the homogeneous illumination of the flat, especially the kitchen countertops, the dining room table, and the work area. Attention should be paid to the path from the bedroom to the bathroom and other basic routes, where adding handrails and other supports can significantly improve safety (Katarzyna et al., 2018).

5. The Importance of *Active Aging* and Natural Environments

A wide range of studies have documented how the level of exposure to the natural environment affects physical and mental health. The presence of green elements in housing neighbourhoods, in addition to playing an important role in mitigating the climate impact of the built environment and improving the eco-climatic conditions of cities, offers great health benefits for people of all ages (Engemann et al., 2019). Thus, the conscious integration of green nature into the daily lives of older people contributes to their wellbeing through their healing properties that avoid and ameliorate depression.

This subtle way of reducing the probability of mental illness is not only effective in reducing psychological stress in older people, but also unconsciously helps them to find their self-worth through plant care and can add vitality in old age (Chalfont & Walker, 2013).

In the wake of the Covid-19 pandemic, it has become even more important to study the impact of home greening, including indoor plants, on the well-being and health of residents. Prioritizing the enhancement of green spaces, including elements such as green roofs, green walls, and communal gardens, in both existing and new buildings is essential to promote vitality in older people (D'Alessandro et al., 2020).

Already back in 1987, the theory of *green visual acuity* (Aoki, 1987) showed that people feel most comfortable when the green colour reaches 25% of their field of vision. Statistically speaking, the *green visual acuity* of long-lived areas in the world is above 15%, which is also a new ecological concept: *visual ecology* (Xiao & Wei, 2018). Valdez and Mehrabian (1994) conducted an emotional modelling study in which they found that certain colours triggered specific emotional responses, and that older people showed higher sensitivity to positive green stimuli (Mammarella al et, 2016). Furthermore, several studies have highlighted how viewing greenery from building windows can have a beneficial effect on stress reduction, especially when natural elements or landscapes are daily visible (Labib et al., 2020), and it can even help to speed up the recovery process of hospitalized patients (Berto et al., 2015). Therefore, incorporating green elements in buildings and its

surroundings (Fig. 8) has become an important aspect, especially for older residents, considering that they tend to spend longer periods at home compared to younger residents.

Figure 8. Sargfabrik Housing, Vienna, BKK-2 Architects, 1994. Older people in dense urban areas can benefit from green roofs and sun exposure, which improves their mood as they tend plants, or even by seeing them from the window (Photo: António Carvalho, 2023).

Outdoor green spaces provide more opportunities for physical exercise and leisure activities, which can help to promote well-being and social relationships and reduce the frequency of various diseases such as coronary heart disease, bone disease, anxiety, depression and diabetes (Maas et al., 2009). At the same time, *green exercise* (physical activities in natural environments) can help to regain concentration (Berman et al., 2008), and being immersed in nature can be effective in

improving blood pressure. Exercising outdoors has a greater impact on participants than exercising indoors, and exercising in nature can make it easier to reduce anxiety, anger, fatigue, and depression (Gyasi, 2022). People are more inclined to spend time outdoors in pleasant green spaces, thus the attractiveness of natural clusters around residential areas can stimulate this behavioural pattern to increase social cohesion and vitality in old age.

6. Conclusion

Assistive technologies (sensors, surveillance, health monitoring systems, VFAI, virtual assistants, social robots, etc.) can be incorporated on newly built housing as part of the whole infrastructure system or added later to existing spaces, when necessary, therefore creating *Smart Homes*. In either case, architectural design solutions are crucial to coordinate the discrete incorporation of the IT technologies and assure the final domestic atmosphere of the environment, to avoid being rejected by older residents, concerned about privacy, autonomy, and psychological comfort of their homes.

In fact, the *Smart Home* tech industry has not paid enough attention to cybersecurity and privacy, important issues to be considered. In addition, the ethical implications of social robots as guardians and caregivers for older people are also debatable. Nevertheless, despite some concerns about security and loss of privacy, community-dwelling older adults are willing to adopt *Smart Home* technologies to support their independence and *ageing in place*, which they value the most.

Façade depth is essential to integrate climate, social, and health factors when designing elevations, to create balconies that meet diverse needs, promote health, and deliver restorative experiences. Balconies profoundly influence residents' quality of life but also the urban atmosphere and liveability for passers-by and residents alike. Balconies and façade composition are vital aspects of residential design, and they serve functions like thermal comfort, air quality enhancement, emotional well-being, and nature connection. In the pandemic context, the façade openings (big or small windows, protruding or recessed balconies, terraces, rooftops) had an immediate impact on inhabitants' comfort and health. And the pandemic lockdown promoted the rediscovery of the overlooked spaces of balconies as *Post-Domestic communication hubs*, responding to the new public health social distancing rules.

The Covid-19 pandemic accelerated and established the work from home all around the world, making *smart work* the new normal for many people. Therefore, homes became *Post-Domestic spaces* serving new permanent purposes: working, studying, relaxing, entertaining. This means that considerations of visual and thermal comfort (avoiding excessive glazing and overheat) and interior flexibility gained paramount importance. Thus, adapting lighting and thermal strategies to respond to these various needs and creating suitable façades and shading conditions for windows using features like the balcony depth, green planting, shading devices, operable blinds, vertical screens, and cross-ventilation significantly influences the residents' perception of a new *Post-Domestic comfort*.

On the other hand, the pandemic lockdown also sparked a trend in pro-nature design, as visual exposure to natural surroundings reduces anxiety and enhances mental well-being. Interaction with nature prompted a rise in small-scale urban agriculture in spaces like sunrooms and balconies, facilitating engagement with nature. Among other age groups, older people can benefit significantly from access to green areas, as these spaces encourage physical activity, counteract social isolation, and slow down functional decline making them less likely to experience symptoms of depression and anxiety during a pandemic than those who had less contact with nature. This also highlights the importance of private or condominium green spaces as safe havens for residents during lockdowns, a factor to be considered in urban and residential design in the new *Post-Domestic* condition we are living in.

The development of *flexible housing* is essential throughout the life cycle, in ways that allow the occupants to change the layout to some extent, to live in their housing in various forms and without limiting the specific functions of the housing, adapting it to the different needs of the family. On the contrary, living spaces that do not correspond to the physical characteristics and needs of the user may create barriers to the full utilization of the room and in some cases may even become a real source of danger. Therefore, housing based on full accessibility, open floor plans, flexible furniture and multiple uses, can offer a seamless, safe and adaptable *flexible Post-Domestic environment* to all residents, including senior citizens.

Active ageing, in the sense of keeping physically active, must be a priority for older people because it promotes well-being and social relationships and reduces the frequency of various diseases such as coronary heart disease, bone disease, anxiety, depression and diabetes. Besides, research has proven that *green exercise* (physical activities in natural environments) can help to regain concentration, and being immersed in nature can be effective in improving blood pressure. On the other hand, exercising outdoors has a greater impact on participants than exercising indoors, and exercising in nature can improve health, therefore highlighting the importance of incorporating the design of appealing green spaces into the urban and architectural design, with a special focus on residential areas.

Our final conclusion on *Post-Domestic habitats for ageing*, might be an urgent call for the need of incorporating new answers into the global architectural and urban design process: traditional aspects such as façade composition need to be addressed in terms of *façade depth*, to create places to stay, while interior architectural design needs to be approached holistically in the sense of *lifelong* spaces to respond to new needs (work, business, exercise) other than the traditional residential ones. And, focusing on housing to *age in place*, the incorporation of different levels and types of tech devices, can create *Smart Homes* as a new answer to a new social reality. Finally, and framing these new aspects of a *Post-Domestic Habitat*, the presence of green elements, both in outdoor and indoor spaces needs also to be considered for its mental and physical health benefits, besides the traditional beauty aspects.

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She is a member of the *Carceral Geography Working Group (CGWG)* (UK), *AtGender* (NL) and SOPCOM (PT) research entities. As an artist, she works with extended vocal techniques and electronics, producing sound for staged performances, exhibitions and films both in collaborations and as a soloist.
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In 2004 he founded Ghigos studio and, since then, has carried out both theoretical research and projects awarded in international competitions. In particular, he is now investigating the potential of interaction design and new digital fabrication technologies from a circular economy perspective.
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He is a PhD candidate, Department of Architecture and Urban Studies at Politecnico di Milano, Italy. With a background in architecture and interior design, Jiarui has pursued academic research and practical projects in both China and Italy, providing a rich, cross-cultural perspective on spatial design and urban development. His primary area of research focuses on the *Pro-*

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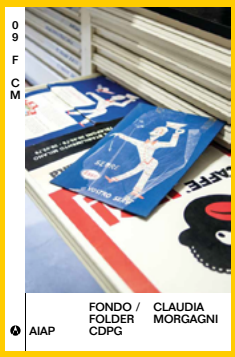

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