

RESIDENTIAL ARCHITECTURE RESPONSIVE TO LONGEVITY: RETHINKING HOUSING BASED ON NEUROSCIENCE AND AGING-IN-PLACE

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Abstract: The relevance of housing suitable for aging stands out, as the satisfaction of living longer is intrinsically linked to opportunities for active life and social inclusion. Built spaces must provide flexible environments, adaptable to the needs of users, regardless of age. The absence of these considerations compromises the adherence of the elderly public, who aim to meet their needs throughout their lives when purchasing a new property. Given the increase in life expectancy, this article proposes a preliminary review aimed at those interested in making elderly people potential targets for future real estate developments, ensuring the satisfaction of their demands. The integrative bibliographic review methodology was adopted, based on neuroscientific evidence to explore its applicability in estate planning. The main aspects include health throughout life, impacts of residential architecture and the role of elderly people in the real estate context, guided by neuroscience. The results aim to provide guidelines for projects that meet the specific needs of the elderly population, aligning architecture and housing planning with the knowledge proposed by neuroscience and “aging-in-place”. This harmonization aims to promote the quality of life and satisfaction of current and future elderly people, proposing an enriching trajectory for their aging.

Keywords: Residential architecture. Elderly. Aging-in-place. Health. Neuroscience.

INTRODUCTION

When outlining the population segment aged 60 and over, the survey conducted by the Brazilian Institute of Geography and Statistics (IBGE) in 2022 recorded a total number of 32,113,490 elderly people, corresponding to approximately 15.6% of the current population. In 2010, the same age group represented 10.8%, showing an increase of 4.8% in a period of just 12 years. The average age of the Brazilian population has increased

by 6 years since 2010, reaching 35 years in 2022, while the aging rate has increased, indicating 55.2 elderly people for every 100 children aged 0 to 14, compared to 2010, when the rate was 30.7 for every 100 children.

The notable discrepancy between the speed observed in the demographic transition in developed countries and that expected in developing countries stands out. According to data from the World Health Organization (WHO) from 2015, while France took around 150 years for the share of the population over sixty years of age to go from 10% to 20% of the total, Brazil, China and India project carry out such a transition in an interval of just 20 years.

Faced with this gradual aging process, it is imperative that architects, designers and urban planners prepare and initiate a reconsideration of the conception of space, aiming at the healthy aging of the Brazilian population. In this context, the main sensory changes manifested during the human aging process will be addressed, based on the knowledge of gerontology and geriatrics, as set out in the “Treatise on Geriatrics and Gerontology”, edited by Elizabete Viana de Freitas and Ligia Py (DE FREITAS; PY, 2013).

Based on this understanding of the sensory changes inherent to aging, it is possible to plan solutions and approaches related to residential architecture with the purpose of promoting the concept of “aging in place”, also known as “aging in one’s own home” for current and future people. elderly. As recommended by the WHO, “aging in place” refers to the ability to continue living at home and in the community over time, maintaining independence, security and autonomy.

Historically, housing production in Brazil has been strongly linked to the expansion of the urban real estate sector, targeting independent, autonomous and economically active adults. However, these dwellings, over time, became standardized, rigid and

progressively smaller, impacting the lifestyle of their inhabitants (FRANÇA, 2019). Given the aging population, it is imperative to remodel these homes to accommodate an elderly population, demanding flexible and gradually adaptable housing.

Internationally, residential architecture projects already offer innovative solutions for the elderly population, such as “senior residences”, which provide technological, safe, integrative and flexible services, catering to different lifestyles (TRECARTIN; CUMMINGS, 2018). In Brazil, this emerging demand, according to studies by Zdankin and Weis (2020), facilitates adaptations in projects, despite cultural barriers, such as “ageism”, which contributes to the scarcity of products suitable for the elderly public in the residential market (GOLDENBERG, 2020; RABELO, 2017).

In the state of São Paulo, enterprises are already exploring the niche market for seniors, recognizing the growing importance of this audience. However, the current offer, labeled as “Senior Residential”, ends up reinforcing stigmas and alienating the target audience (VENCES et al., 2020). Entrepreneurs and architects must be aware of post-pandemic behavioral changes and the biopsychosocial needs of the elderly population.

The satisfaction of living longer is intrinsically linked to the opportunity for an active life, constant updating and integration into society, without restrictions to isolated environments. Therefore, the concern of the elderly is to maintain autonomy and independence in all areas of life. The challenge lies in creating housing environments responsive to human aging, which promote not only inclusive infrastructure, but also integration and sociability (SILVA, 2020).

Longevity, in itself, is not an advantage if it is not accompanied by the possibility of enjoying a suitable quality of life. In old age,

individual characteristics acquire greater prominence than at any other stage of life, manifesting themselves in different spheres such as physical, mental, psychological, social and economic, thus giving a highly individualized character to the concept of quality of life.

Living well, in this context, is intrinsically related to the ability to adapt emotionally, cognitively and behaviorally to natural changes in life. Therefore, the importance of favorable conditions for the preservation of autonomy, identity, integrity and independence is highlighted. Interaction with the environment, as highlighted by Gerontology, plays a crucial role in maintaining, increasing or reducing quality of life, directly reflecting on health indicators (DE FREITAS; PY, 2013).

In this scenario, the concept of “Aging-in-Place” emerges as a promising approach to build space, favoring longevity. This concept advocates staying in the community, with some degree of independence, as opposed to residential care (DAVEY et al., 2004, p. 133). Policies aligned with this idea are supported by the preference evidenced by extensive literature, indicating that elderly people wish to remain in their homes as they age (LEWIS; BUFFEL, 2020; MEANS, 2007), promoting well-being and social connectivity (WILES et al., 2012).

The promotion of “Active Aging”, according to the pillars defined by the Pan American Health Organization (PAHO), highlights the importance of health, lifelong learning, protection and safety. However, clustering elderly people in specific residences is inadvisable, as it limits the search for intergenerational relationships and reinforces ageism. Therefore, strategies that address accessibility, safety, socialization, physical activity and affective memories become imperative in architectural design to enhance the experience of elderly users.

Applied Neuroscience emerges as a promising tool for harmonizing marketing interests with the needs of the long-lived public. However, to effectively incorporate the “aging-in-place” concept into architectural design, it is essential to consider factors such as accessibility, safety, insulation, temperature, lighting, size of the house and distances to be covered (DAVEY et al., 2004). A comprehensive approach, paying attention to socialization, physical activity, affective memories and other aspects, is necessary to enhance the experience of elderly users.

Given this scenario, longevity-responsive residential architecture strategies must consider economic, social, cultural, gerontological and neuroscientific aspects to offer housing suited to the needs of a lifetime. The objective of this research does not lie in the evaluation of existing products, but rather in the presentation of an integrative literature review aimed at those interested in proposing residential architectural projects responsive to active aging in the national context, thus meeting the needs identified in this audience. The central focus is promoting the quality of life and protagonism of these individuals (OPAS, 2005).

NEUROSCIENCE APPLIED TO RESIDENTIAL ARCHITECTURE FOR LONGEVITY

Acquiring housing represents the most significant financial investment in most people’s lives, imposing considerable responsibility in the design of the architectural project. Although the sale may be the desired outcome from a commercial point of view, it is imperative that the entire design is approached with technical rigor, respect and honesty, recognizing the importance of this space in the lives of the occupants.

The need for connection with the environment is essential at all stages of

life, requiring affection and interaction in a network of communication and mutual obligations. Maintaining social life plays a crucial role in the perception of quality of life, facilitating adaptation to the physical changes inherent to aging. This perspective is intrinsically linked to the concept of environmental quality, addressing aspects such as safety, socialization, recreation and leisure to guarantee a space that does not limit physical and social activities.

Each environment impacts positively or negatively, more or less intensely, since our senses are constantly active. The experience with architecture is inherently multisensory, generating emotions that originate from the capture of stimuli by our senses, followed by biological processes until interpretation and categorization in subcortical regions. Recognizing this deep interconnection with the environment, whether natural or built, is essential.

In the context of purchasing housing, this understanding becomes even more relevant, as it is in the home that we deposit our feelings and where we find our identity. Home is more than a physical space; It is our second skin, our protective cloak, where we express our fragility and recharge our vital energy.

Aiming to offer and attract the elderly public, considering the investment in housing for life, the experience in the built space must be approached in a multisensory way. Aspects such as space, material and scale must be evaluated through the eyes, ears, nose, skin, tongue, skeleton and muscles, strengthening the feeling of belonging to the home and the surroundings (PALLASMAA, 2011).

The loss of biological adaptability associated with aging makes the elderly more susceptible to immediate environmental influences, requiring a more valuable affinity with the environment to maintain comfort and safety (PALLASMAA, 2011). In this

context, residential architecture projects must consider six constructive aspects identified in the review as the most relevant for the proposed objective: the quality of indoor air (i), the flexibility of the space (ii), the quality of materials (iii), the connection with the external environment (iv), natural aspects (v) and integration with the local community (vi). These elements, according to the analyzes proposed by this study, are essential to ensure that homes are adaptable spaces and responsive to the constantly evolving needs of the occupants, thus promoting a lasting quality of life.

INDOOR AIR QUALITY, SPACE FLEXIBILITY AND QUALITY OF MATERIALS

[...the average life of a building is 100 years. During this period, the way the building is used will change radically and repeatedly. Often, attempts made to solve this problem make use of ingenious flexible structures that can be easily changed. The keyword here is flexibility. But the emphasis in developing this concept [...] is not on what can be changed, but on what can be permanent and lasting. By determining what can be permanent now, opportunities can be created to deal with future unpredictability (LEUPEN, 2005, p.18).

Therefore, in addition to health, housing designed for life must incorporate a flexible architecture, whose configuration meets different ways of life and evolves naturally, simultaneously preserving indoor air quality and allowing the appropriate choice of materials compatible with new configurations. (DAVEY et al., 2004). Regular accessibility and flexibility of spaces, including openings in facades and plumbed wet areas, become essential to meet the constantly evolving needs of occupants. Universal design, combined with understanding the impact of aging on mobility and agility, is an essential

requirement to guarantee an adaptable and safe environment [1].

Furthermore, for an effective design conception, professionals involved in the development of projects must strive for an in-depth understanding of how aging impacts critical variables, such as mobility and agility, decreased visual, auditory, tactile and balance acuity (DE FREITAS; PY, 2013). Additionally, the analysis of psychological ramifications inherent to this natural process is relevant, encompassing phenomena such as denial, depression, loss of social connection, loneliness, prejudice and the consequent dependence on third parties (GOLDENBERG, 2020; RABELO, 2017).

These considerations are intrinsically related to the primordially of the physical and multisensory experience in the built environment, thus exerting a significant influence on the selection of materials. In accordance with the Well Building Standard (2020, p. 222), due diligence in choosing construction materials must consider the reduction or elimination of human exposure to potential risks. Through direct contact with products or environmental contamination, chemical substances harmful to human health, used during the construction, renovation, decoration or operation phases of buildings, can be mitigated or avoided through the appropriate selection of these finishes.

The quality of the materials plays a preponderant role in the interaction of users with the built space. Such elements give identity to the place, provide visual and aesthetic comfort, ensure the safety and physical integrity of the user, in addition to determining the cleaning routine of the environments [2]. When carefully selected from the design stage, suitable materials do not incur additional costs to the construction budget, adding value to the property and prolonging the building's useful life cycle.

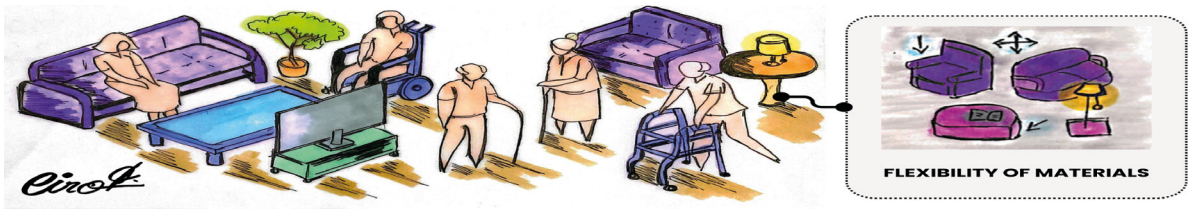


FIGURE 01 - Accessible shared environments, capable of providing flexibility and opportunity to choose ownership for users.

Source: AUTHOR, 2024.

Castelnou Neto (2019, p.11) highlights the quality of the project by stating that:

[...A designed environment meets the physical needs of the elderly if it is free from obstacles and is easy to maintain, in order to avoid accidents. It must be attractive to everyone and be in accordance with the biomechanical and anthropometric characteristics of this user population (CARSTELNOU NETO, 2019, p.11).

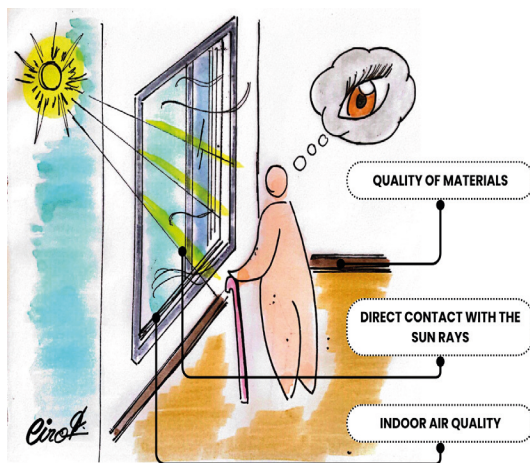


FIGURE 02 - Quality of materials and indoor air quality are essential in the composition of a property for life.

Source: AUTHOR, 2024.

Regarding the informational needs of the long-lived public, these are linked to their perception of the environment. During this period of life, decreased cognitive functioning is common. Thus, the difficulty in perceiving and processing information ends up interfering with the activity of the senses.

In this category, Souza (2017) and Nunes (2018) show that it is relevant to promote the stimulation of more than one sense through the experience lived in the place, so that the elderly has more possibilities in recognizing the information emitted (SOUZA, 2017; NUNES, 2018). Therefore, it is recommended to design legible spaces capable of promoting multisensory stimuli, so that the environment ensures the capture of the information that is being emitted there, even if the user has some sense suppressed.

Therefore, the concept of “aging-in-place”, together with the other topics discussed, contributes to disseminating the understanding that the quality of the internal environment, encompassing air quality, space flexibility and the quality of materials, exerts a significant influence on the quality of life of the elderly, from an interdisciplinary perspective (DAVEY et al., 2004).

Consequently, the residential project must be oriented towards understanding how the environment impacts the lives of long-lived people, both at the individual and community levels, with the aim of promoting aging in the place of residence, minimizing as much as possible the need for transfer to other facilities, as long-term care institutions. This approach not only favors the well-being of the elderly, but also contributes to reducing costs associated with institutions, an advantageous aspect from the perspective of a “home for life”.

CONNECTION WITH THE EXTERNAL ENVIRONMENT, WITH NATURE AND WITH THE COMMUNITY AND SURROUNDINGS

The location and implementation of residential developments are crucial aspects that directly impact the quality of life provided to their inhabitants. The location, in the foreground, plays a determining role in establishing the building's interaction with the urban fabric, defining local mobility and connections with shops and services. The implementation, in the background, delineates the permeability between the public and private domains, between internal and external space [3].

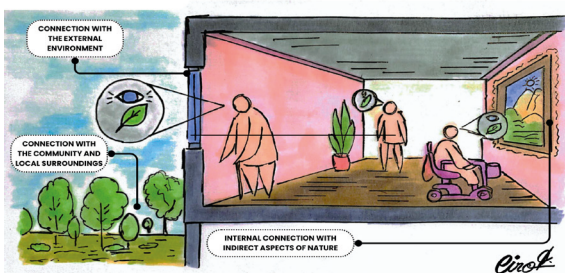


FIGURE 03 - The choice of location will determine the building's connection with the urban fabric and the local community.

Source: AUTHOR, 2024.

According to Castelnou Neto (2019), the social needs of the elderly are linked to the promotion of privacy control and social coexistence. Environments designed for longevity must provide a sense of security and familiarity, facilitating interactions between the community and the neighborhood in a natural way. The relevance of the surroundings and neighborhood stands out as people age, especially in terms of accessibility to local services and facilities.

Studies indicate that older people often express a stronger emotional bond with their neighborhoods compared to younger

people. In this context, the terms “aging” and “rootedness” seem to correlate (GILLEARD et al., 2007). This relationship is possibly associated with the growing familiarity with the place, witnessing urban transformations close to housing. Liggins (2016) relates this connection to identity and complicity with the environment, highlighting that, if the place is understood as intertwined with who we are, exploring this place offers the opportunity to find ourselves. According to the author:

“If the place is understood as [...] intertwined with who we are, then in exploring the place we have the possibility of finding ourselves. We shape and are shaped by place; and the landscape we get to know, in all its richness, becomes the story we tell, the expression of our healing.” (LIGGINS, 2016, p. 143).

In the same sense, the concept of “Healing Spaces”, also known as Healing Spaces, highlights the importance of privileging the connection with nature, incorporating elements such as natural light, natural ventilation and natural sounds in the architectural design. Kaplan (1993) highlights that contemplating natural views through the window can be considered a “micro-restorative” experience, removing frustration and promoting well-being [4].

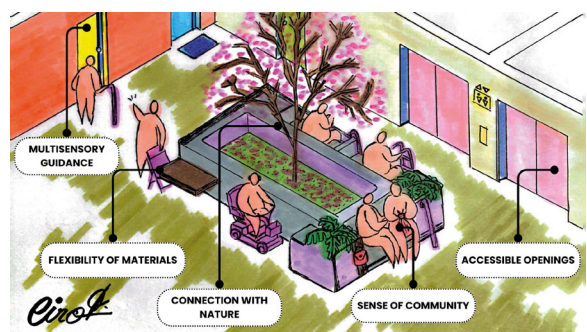


FIGURE 04 - Environments that provide connection with the community and nature, directly or indirectly, provide micro-restorative atmospheres.

Source: AUTHOR, 2024.

Considering nature, combined with the literature review, it is suggested that the guiding principles of “biophilic design” can serve as a starting point to contemplate the multisensory and meaningful experience in housing for the elderly. The biophilia hypothesis, introduced by Wilson (1984), proposes an intrinsic biological affinity between people and nature. The concept of “biophilic design”, presented by Stephen Kellert (2011), translates this hypothesis into architectural and interior design strategies to promote human well-being and environmental sustainability, through direct or indirect contact with natural elements.

Kellert proposes six elements of biophilic design, with an emphasis on three of them:

Multisensory man-nature relationships, fostering places of prospecting and refuge, settings that arouse curiosity and exploration, and opportunities for environmental control.

Environmental resources that incorporate recognizable features of nature, such as color, water, sunlight, views, plants, animals, and natural materials.

Atmospheres of belonging to the place, integrating geographic, historical, ecological and cultural connections in the environment [5].

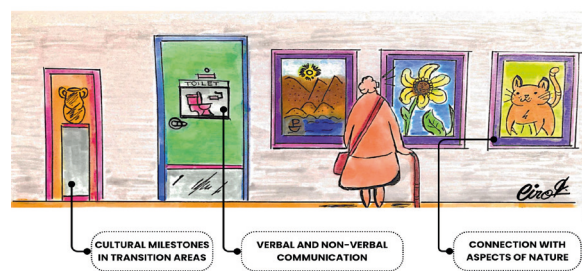


FIGURE 05 - Biophilic Design’s primary factor is to enable the user to have direct or indirect contact with aspects of nature.

Source: AUTHOR, 2024.

In the context of residential developments, the integration of biophilic resources, such

as indoor plants, drinking fountains and aquariums/terrariums, can offer complex multisensory stimuli to the elderly, promoting longevity, biopsychosocial health and quality of life. These elements provide an immersive experience that stimulates the senses and introduces novelty, essential elements for well-being as they change unpredictably over time and interact with other aspects of the environment.

Finally, it is pertinent to consider that spaces intended for people with mobility limitations can be designed to provide immersive experiences that invite exploration. Accessibility to well-lit places, with abundant vegetation, pleasant sounds and design congruent with the proposed atmosphere must be guaranteed to everyone, regardless of their motor or sensory limitations. This approach aims to create inclusive environments and promote social interaction in an enriching context.

RESULTS AND DISCUSSIONS

The conceptualization of quality of life is a complex undertaking, intertwining various elements such as health, comfort and sustainability in the built environment. In the context of residential architecture, quality of life gains a significant dimension, especially when aimed at human longevity. Despite the abundance of scientific research, evidence and instruments that guide the design of more humanized buildings, few projects are designed with an eye on adaptation throughout all stages of life.

Longevity, as a concept, is intrinsically linked to the expansion of the definition of health, encompassing not only medical aspects, but also the quality of food, housing, income, level of education, work, leisure and access to various services. This way, the multidisciplinary nature inherent to the topic highlights its importance, particularly in the

context of Economics and, more specifically, in the context of the Real Estate Market.

The real estate sector is gradually waking up to the vast potential that exists in architecture aimed at promoting health and increasing life expectancy. As we contemplate the future of homes, we anticipate a smarter use of technology, with innovations and new metrics designed to establish a deeper understanding of well-being and its relationship to the built environment. Qualifying these aspects represents an exponential increase in sales, enabling the creation of flexible and adaptable homes throughout the different stages of the lives of its inhabitants.

The constructive aspects highlighted as essential in the projection of residential architecture responsive to longevity are presented below:

Location and Implantation: the choice of location is crucial, determining the building's connection with the urban fabric and the local community, influencing mobility and connections with commerce and services.

Biophilic Design: considering the hypothesis of biophilia, biophilic design proposes the user's direct or indirect connection with aspects of nature, promoting well-being.

Indoor Air Quality: to guarantee a healthy environment, it is vital to ensure healthy parameters in ventilation, lighting, temperature, acoustics and odor, considering the careful choice of materials.

Space Flexibility: designing flexible spaces that adapt to different stages of life, considering mobility and constantly changing needs.

Universal Accessibility: ensure regular accessibility when circulating between environments, in doorways and within rooms, promoting an inclusive environment.

Healing Spaces and Multisensory Stimuli: provide environments that stimulate the senses, such as natural light, ventilation,

sounds of nature, promoting multisensory experiences.

Another crucial concept to be explored was indoor air quality. From this perspective, it is imperative to consider criteria that make a built environment conducive to health. This encompasses parameters related to "ventilation, lighting, temperature, acoustics and odor" (BLUYSSSEN, 2015, p.03). In addition to the configuration of the spaces, the careful choice of materials plays a fundamental role in this context.

As highlighted by Lecovich (2014), most elderly people want to grow old in their own home, maintaining autonomy, activity and independence for as long as possible. Relocation to senior housing or long-term care facilities often results from inadequacies in the residential environment to meet the evolving needs of older adults. Such inadequacies may include declines in health, accessibility barriers, loneliness and lack of necessary services.

Far from being a passing trend, as highlighted by Lawlor and Thomas (2008), homes for a lifetime emerge as a permanent and gradual evolution in the way of living, aligning with the demands for sustainable and conscious practices. This paradigm will directly impact the work of professionals such as interior designers, architects and builders, outlining a promising horizon for future ventures.

FINAL CONSIDERATIONS

In summary, the longevity-responsive residential architecture approach emerges as an innovative and essential field in the quest to promote the quality of life of inhabitants throughout all phases of their lives. The complexity of this undertaking demands careful consideration of multiple construction elements that have been highlighted throughout this text.

The architectural project, as the centerpiece of this approach, must include location and implementation, with an emphasis on integration with the local community, urban mobility and access to services. The application of biophilic design, supported by the hypothesis of biophilia, presents itself as a fundamental strategy, promoting an intrinsic connection with nature and generating environments that provide multisensory experiences.

The quality of indoor air, including ventilation, lighting, temperature, acoustics and careful choice of materials, plays a critical role in creating healthy environments conducive to longevity. The flexibility of the space, combined with universal accessibility, reinforces the need to design spaces that adapt to changes in needs and mobility over time.

The concepts of “healing spaces” and multisensory stimuli, based on evidence from neuroscience applied to the built environment, highlight the importance of environments that not only accommodate,

but also promote mental and emotional well-being. Considering psychological aspects, such as how aging impacts mobility and agility, sensory loss and natural psychological consequences, offers a comprehensive vision for developing truly adapted spaces.

Finally, global trends indicate that the transition to whole-of-life homes is not a mere fad, but a significant evolution in the way we design our living environments. This not only responds to growing demands for sustainable practices, but also reveals a more holistic and humanized approach to housing.

The aging of the population poses a challenge and an opportunity to architecture, which, by incorporating these constructive elements and neuroscientific considerations, can not only meet the needs of longevity, but also comprehensively enrich the quality of life. In this scenario, architecture professionals have the unique opportunity to shape environments that transcend mere functionality, becoming catalysts for a dignified and meaningful life throughout the entire journey.

REFERENCES

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS (ABNT). **NBR 9050:2020**: Acessibilidade a edificações, mobiliário, espaços e equipamentos urbanos. 2020. Rio de Janeiro, 2020.

BLUYSSSEN, Philomena. **All you need to know about indoor air**. A simple guide for educating yourself to improve your indoor environment. DELFT Academic Press: Delft University of Technology, Netherlands, 2015.

BURZYNSKA, Aga; MALININ, Laura. **Enriched Environments for Healthy Aging**: Qualities of Seniors Housing Designs Promoting Brain and Cognitive Health, 2017.

CASTELNOU NETO, Antonio Manoel Nunes. Por uma gero-arquitetura: a inclusão dos idosos no processo projetual. *Arquitetura e Cidade: privilégios, conflitos e possibilidades*. 9 Projotar 2019. Curitiba, 2019. Disponível em: http://projodata.grupoprojetar.ct.ufrn.br/dspace/bitstream/handle/123456789/1198/_Artigo%20Hors%20Concurs_Antonio%20MN%20Castelnou%20Nt.pdf?sequence=1&isAllowed=y. Acesso em: 22 dez. 2023.

DE FREITAS, E. V.; PY, L. **Tratado de geriatria e gerontologia**. Elizabete Viana de Freitas e Ligia Py [et al.]. - 3.ed. - [Reimpr.]. - Rio de Janeiro : Guanabara Koogan, 2013.

DORNELES, V. G.; Vielmo, G.; ELY, V.H.M.B. **Envelhecimento e arquitetura**: as necessidades espaciais dos idosos em espaços abertos. *REVISTA PIXO: arquitetura, cidade e contemporaneidade*, v. 4 n. 13 (2020): ENVELHECER NO LUGAR I (outono), 2020. Disponível em: <https://revistas.ufpel.edu.br/index.php/pixo/article/view/2733>>. Acesso em: 23 dez. 2023.

FANGE, A. M. *et al.* **Aging in Place in Late Life: Theory, Methodology, and Intervention**. Editorial, Open Access, Volume 2012 | Article ID 547562, *Journal Of Age Research*, 2012. Disponível em: <https://doi.org/10.1155/2012/547562>>. Acesso em: 15 dez 2023.

FRANÇA, B. L. P. de O. **Da teoria urbana ao regime Urbano:** contribuições como teoria e como método para interpretar as relações de poder interativas na cidade. Texto para Discussão 2. Rio de Janeiro: Observatório das Metrôpoles, 2019. Disponível em: https://www.observatoriodasmetrolopes.net.br/wp-content/uploads/2019/09/TD-002-2019_Barbara-Franca_Final.pdf. Acesso em: 15 dez 2023.

GOLDENBERG, Mirian. Velhofobia. **A face mais perversa da pandemia ficou evidente.** Folha de São Paulo, São Paulo, 09 de abr. de 2020. Disponível em: <https://www1.folha.uol.com.br/colunas/miriangoldenberg/2020/04/velhofobia.shtml>. Acesso em: 29 dez. 2023.

GIODA, A.; NETO, F. R. A. **Considerações sobre estudos de ambientes industriais e não industriais no Brasil: uma abordagem comparativa.** Caderno de Saúde Pública, v.19, p.1389-97, 2003.

GILLEARD, C.; HYDE, M.; HIGGS, P. **The impact of age, place, aging in place and attachment to place on the well being of the over 50s in England.** Research on Aging 29(6), 2007, pp.590–605.

GILLEARD, Chris; HYDE, Martin; HIGGS, Paul. **Community and Communication in the Third Age: The Impact of Internet and Cell Phone Use on Attachment to Place in Later Life in England.** *The Journals of Gerontology: Series B*, Volume 62, Issue 4, July 2007. pp. 276–S283.

HOJO, S. *et al.* **Use of QEESI questionnaire for a screening study in Japan.** Toxicology and Industrial Health, v.21, p.113-24, 2005.

IECOVICH, Esther. **Aging in place: From theory to practice.** Anthropological Notebooks, XX/1, 2014. Disponível em: <<http://ojs.westeurope.cloudapp.azure.com/Notebooks/article/view/200/175>>. Acesso em: 20 dez 2023.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE. **Pesquisa Nacional por Amostra de Domicílios Contínua:** características gerais dos domicílios e dos moradores 2017. Rio de Janeiro: IBGE, 2019. Disponível em: https://biblioteca.ibge.gov.br/visualizacao/livros/liv101654_informativo.pdf. Acesso em: 04 dez. 2023.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE. **Pesquisa Nacional por Amostra de Domicílios Contínua:** características gerais dos domicílios e dos moradores 2017. Rio de Janeiro: IBGE, 2018a. Disponível em: https://www.unfpa.org/sites/default/files/pub-pdf/Portuguese-Exec-Summary_0.pdf. Acesso em: 04 dez. 2023.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE. **Síntese de indicadores sociais:** uma análise das condições de vida da população brasileira. Rio de Janeiro: IBGE, 2018b. Disponível em: https://www.unfpa.org/sites/default/files/pub-pdf/Portuguese-Exec-Summary_0.pdf. Acesso em: 05 dez. 2023.

JANSSEN, J.E. & WOLFF, A.. **Subjective response to ventilation. In: Managing indoor air for health and energy conservation.** Proceedings of the ASHRAE Conference IAQ' 86. Atlanta, USA, 1986.

KAPLAN, R. **The role of nature in the context of the workplace.** Landscape and Urban Planning, 26, 1993, p.193–201.

LAWLOR, Drue. THOMAS, Michael A. **Residential design for aging in place.** John Wiley & Sons Inc: New Jersey, 2008.

KELLERT, S. R., HEERWAGEN, J., & MADOR, M. **Biophilic design: the theory, science and practice of bringing buildings to life.** John, Wiley & Sons, 2011.

LEUPEN, Bernard. **Towards Time-based Architecture.** In LEUPEN, Bernard; HEIJINE, René; ZWOL, Jasper ven. *Time-based Architecture.* 101 Publishers: Delft University of Technology, Netherlands, 2005.

LEWIS, C.;BUFFEL, T. **Aging in place and the places of aging:** A longitudinal study, Journal of Aging Studies, Volume 54, 2020. Disponível em: <<https://doi.org/10.1016/j.jaging.2020.100870>>. Acesso em: 22 dez 2023.

LIGGINS, Jacqueline. **A Place for Healing in Mental Health Care and Recovery.** The University of Auckland, NZ, 2016.

MEANS, R. Safe as houses? **Aging in place and vulnerable older people in the UK.** Social Policy and Administration, 41,v.1., pp. 65-85, 2007.

- NUNES, F. A. S. **Centro habitacional para idosos portadores do mal de Alzheimer em Curitiba PR**. Curitiba: Monografia (Trabalho Final de Graduação em Arquitetura e Urbanismo), UNIVERSIDADE FEDERAL DO PARANÁ – UFPR, 2018. Coedição Teresina, PI: EDUFPI, 2017. p. 99-114.
- ORTMAN, JM; VELKOFF VA.; HOGAN H. **An Aging Nation: The Older Population in the United States**. Washington, DC: United States Census Bureau, Economics and Statistics Administration, US, 2014.
- ORGANIZAÇÃO PAN-AMERICANA DA SAÚDE (OPAS). **Envelhecimento ativo: uma política de saúde / World Health Organization**; tradução Suzana Gontijo. – 60 p.: il. Título original inglês: Active ageing: a policy framework, 2005.
- PALLASMAA, Juhani. **Os olhos da pele: a Arquitetura e os sentidos**. [trad. Alexandre Salvaterra]. Porto Alegre: Bookman, 2011.
- RABELO, Dóris. Firmino; DAVI, Edmar H. Preconceito e discriminação contra o idoso e as práticas gerontológicas. In: CARVALHO, C. M. R. G.; ARAÚJO, L. F. **Envelhecimento e Práticas Gerontológicas**. Curitiba PR: CRV, 2017.
- ROSSETTO C, SOARES JV, BRANDÃO ML, ROSA NG, ROSSET I. **Causas de internação hospitalar e óbito em idosos brasileiros entre 2005 e 2015**. Rev Gaúcha Enferm. Universidade Federal do Rio Grande do Sul (UFRGS), Escola de Enfermagem. Porto Alegre, Rio Grande do Sul, Brasil, 2019.
- SOUZA, H. M de. **Centro de convívio e assistência ao idoso em Curitiba PR**. Curitiba: Monografia (Trabalho Final de Graduação em Arquitetura e Urbanismo), UNIVERSIDADE FEDERAL DO PARANÁ – UFPR, 2017.
- SILVA, Josevânia da. **Saúde mental de idosos no contexto da COVID-19**. Campina Grande: EDUEPB, 2020.
- THAYER, W.W.. **Tobacco smoke dilution recommendations for comfortable ventilation**. *ASHRAE Transactions*, 88: 291-3-6, 1982.
- TRECCARTIN, S. M., & CUMMINGS, S. M. **Systematic review of the physical home environment and the relationship to psychological well-being among community-dwelling older adults**. *Journal of Gerontological Social Work*, 2018. Disponível em: <<https://doi.org/10.1080/01634372.2018.1463339>>. Acesso em: 4 jan. 2024.
- VENCES, N. A.; DÍAZ-CAMPO, J.; ROSALES, D. F. G. **Neuromarketing as an Emotional Connection Tool Between Organizations and Audiences in Social Networks**. A Theoretical Review. *Frontiers in Psychology*, v. 11, 2020. Disponível em: <<https://www.frontiersin.org/articles/10.3389/fpsyg.2020.01787>>. Acesso em: 17 dez. 2023.
- WELL v2. Dynamic, resilient, validated. **The next version of the WELL Building Standards**. Copyright 2020 International WELL Building Institute, pbc., 2020.
- WILSON, E. O. **Biophilia** (Revised ed. edition). Cambridge, Mass.: Harvard University Press, 1984.
- WORLD HEALTH ORGANIZATIONS. **Indoor Air Pollutants: Exposure and Health Effects**. Copenhagen. WHO regional Office for Europe (European Series nº 78), 1983.
- WORLD HEALTH ORGANIZATIONS. **Indoor Air Quality**. Biological contaminants. Copenhagen. WHO regional Office for Europe (European Series nº 31), 1990.
- WORLD HEALTH ORGANIZATION – WHO. **The right to health indoor air**. Biltoven, 2000.
- WILES, JL; LEIBING, A; GUBERMAN, J; REEVE, RE. **The meaning of “aging in place” to older people**. *The Gerontologist*, 52, v.3, pp. 357-366, 2012.
- ZDANKIN, P. E WEIS, T. **Longevity of Smart Homes**. IEEE International Conference on Pervasive Computing and Communications Workshops (PerCom Workshops), 2020, pp. 1-2. Disponível em: <<https://ieeexplore.ieee.org/document/9156155>>. Acesso em: 4 jan. 2024.