

Exploring Livability in Pune's Urban Housing: A Comparative Analysis Across Typologies

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Abstract

Pune, India, has evolved from a Maratha capital into an industrial, educational, and IT hub, influencing housing typologies. Traditionally, wadas and chawls reflected indigenous knowledge and local craftsmanship. Later, low-rise housing by Pune-based architects emerged, followed by high-rise developments by Indian and international design firms. While these shifts introduced diverse design philosophies, they also diluted Pune's cultural identity. This study explores livability across Pune's housing environments through 14 case studies spanning formal and informal housing. Conducted in 2024 by fourth-year B.Arch. students at S.M.E.F.'s Brick School of Architecture, Pune, the research assesses tangible and intangible aspects of livability in housing using criteria like well-being, environmental quality, economic viability, social inclusivity, resilience, and overall quality of life. The study identifies a spatial vocabulary of livability, offering adaptable design frameworks to enhance housing conditions. Findings emphasize the need for sustainable design and inclusive urban policies to bridge disparities between housing types. This research highlights the potential for equitable, resilient, and culturally cohesive communities, providing insights for a more liveable urban environment that meets Pune's diverse needs.

Keywords— Livability, Urban Housing, Pune, Sustainable Design, Informal Settlements, Passive Design

I. Introduction

Livability in urban housing design refers to the quality of life afforded by residential spaces, encompassing physical comfort, access to essential services, safety, and environmental sustainability. The concept has emerged as a critical factor in urban planning and development,

reflecting the overall well-being of residents within urban environments. Recent frameworks and indices, such as those by the National Institute of Urban Affairs (NIUA) and the Economist Intelligence Unit (EIU), have sought to quantify livability across multiple dimensions, recognizing its role in shaping resilient, sustainable, and inclusive cities. These frameworks often emphasize accessibility, housing quality, social cohesion, economic viability, and environmental health as key determinants of livability, highlighting both the technical and human-centric aspects that contribute to an ideal urban living environment. As urbanization accelerates, cities worldwide grapple with increasing population densities and housing demands, creating disparities in living standards between different urban areas. In India, urban growth has been particularly rapid, with informal settlements and slums emerging alongside high-rise residential complexes, representing a spectrum of housing typologies with vastly different standards of livability. Pune, as one of India's fastest-growing urban centres, exemplifies this contrast. The city is Maharashtra state's second-largest metropolis, and is rapidly evolving from a cultural centre to an educational centre and, more recently, into a significant industrial and information technology powerhouse. The housing has a significant impact on the standard of urban architecture and aesthetics. The city's character is also altered by changing housing typologies. Pune's house types' characteristics have changed significantly since the seventeenth century. Moghals, Marathas, Peshwas, and British kings have all ruled Pune till the post-independence era. The migration of different types of people to Pune and their communities and emerging real estate sector are the reasons for the shift in housing typology. Since housing is a reflection of development, this change is attributable to time as well as architectural practices, planning, and technical advancements (Nagapurkar & Narkhede, 2019).

The city that had “wadas” (Shaniwar wada, Vishrambaug Wada, Dhepe Wada, etc.) and chawls in its earlier times, now has advanced housing areas like Amanora Future Towers that offer planned, high-density housing with integrated amenities, green spaces, and advanced infrastructure, while informal settlements, such as those in Market Yard, reflect conditions of overcrowding, limited ventilation, and restricted access to resources. The disparity between these typologies underscores the need for a nuanced understanding of livability that addresses both structural and social challenges within the urban housing landscape. This study aims to investigate livability across diverse urban housing typologies in Pune, drawing comparisons between informal settlements and planned residential complexes to understand how spatial, technical, and social aspects of housing impact residents’ quality of life.

II. Literature review

A. Liveability as a Multi-Dimensional Concept
Livability is a central concept in urban planning and housing design, generally associated with the quality of life and comfort provided by an environment. The National Institute of Urban Affairs (NIUA) in India and the Economist Intelligence Unit (EIU) offer frameworks for understanding livability. According to the NIUA, livability encompasses a range of attributes essential for the well-being of urban dwellers, including access to basic services, safety, housing quality, economic stability, and social cohesion (Ministry of Urban Development, 2019). NIUA emphasizes accessibility to necessities like clean water, healthcare, education, and transportation as crucial to improving urban living standards. This approach aligns with broader policy goals in India aimed at creating inclusive and resilient cities, particularly in fast-urbanizing regions where resources are under pressure due to population growth and migration. The EIU's Global Livability Index, on the other hand, assesses cities worldwide based on stability, healthcare, culture, environment, education, and infrastructure (EIU, 2024). Cities are ranked based on their provision of public amenities, green spaces, and cultural resources that contribute to an attractive and liveable environment. The EIU's framework identifies both universal and region-specific criteria, acknowledging that livability is influenced by cultural and socio-economic contexts, which may vary significantly between developed and developing regions (Frontiers, 2022). This perspective is particularly relevant in countries like India, where disparities in access to urban infrastructure and services often necessitate tailored livability strategies to address local needs.

Livability is increasingly recognized as a multi-

dimensional concept that cannot be captured solely through physical infrastructure or economic measures. McCann (2004) and Hankins & Powers (2009) discuss how livability encompasses both tangible aspects, such as housing quality and public amenities, and intangible aspects, such as social cohesion and environmental health (Tennakoon & Kulatunga, 2019). The effective urban policies must balance individual choices, like lifestyle preferences, with community-focused public infrastructure that supports health and well-being (McCann, 2008). This is particularly relevant in the urban planning domain, where personal consumption choices, like proximity to green spaces or availability of public transportation, are mediated by municipal services and policies that facilitate accessibility and safety. Livability is tied to social interaction and inclusiveness, which can be particularly challenging to maintain in high-density urban environments (LIU et al., 2020).

B. Urban Planning and Livability

Urban livability metrics are essential tools that help planners and policymakers assess and improve the quality of life in cities. Common metrics include access to green spaces, noise levels, pollution levels, and walkability. Access to green space, for instance, is strongly correlated with mental health and physical well-being, offering residents areas for relaxation, exercise, and socialization (Mouratidis, 2021). Noise levels and pollution impact both the physical and mental health of city dwellers, with research showing that prolonged exposure to high noise and air pollution levels can lead to chronic health issues (Frontiers, 2022). Walkability, or the ease with which residents can navigate an area on foot, is linked to both physical health benefits and a reduction in carbon emissions, as people rely less on vehicles (Shamsuddin et al., 2018). These metrics are often used to compare cities on a global scale, but they are relevant to a great extent for Indian contexts. For example, in many Indian cities, informal settlements do not have the same access to clean air, green spaces, or walkable streets as planned urban areas. Poor air quality in densely populated informal settlements often stems from inadequate waste management and reliance on traditional cooking methods, which contribute to indoor pollution (Balakrishnan et al., 2011). Thus, while livability metrics can guide urban improvements, they must be tailored to account for the infrastructural and environmental challenges unique to each city, particularly in the Global South.

C. Global and Local Perspectives on Livability

The Global EIU (Economist Intelligence Unit) framework serves as a benchmark for livability across international

cities, focusing on aspects like healthcare, education, and infrastructure that are vital for a high standard of living (EIU, 2022). However, these criteria often reflect the experiences of cities in developed countries, which may differ from those in developing nations like India. In Indian urban contexts, particularly in informal settlements, livability is impacted by factors such as access to affordable housing, clean air, and community spaces that foster social cohesion (MoUHA, 2018) (Shrivastava et al., 2018). Researchers highlight those informal settlements, which house a significant portion of India's urban population, are often excluded from livability frameworks due to a lack of formal infrastructure (KILLEMSETTY, 2021). Local frameworks for assessing livability in India have begun to address these disparities. The NIUA, for instance, has developed a framework focusing on creating more inclusive cities by improving access to public services, safety, and environmental quality in underserved areas. Studies have shown that livability improvements in these areas contribute significantly to the economic and social well-being of residents (Tuhkanen et al., 2022).

Belonging and psychological comfort through Housing Design in urban and housing design, psychological comfort is essential to creating environments that foster well-being, belonging, and social connection (Altaf E et.al. 2021). Housing design can promote psychological comfort by integrating green spaces, pedestrian-friendly pathways, and accessible social gathering spots, all of which support residents' natural need for connection with nature and others (Ibrahim et al., 2024). Human-scaled streets, buildings, and public areas make urban spaces more inviting, creating a sense of warmth and community that larger, impersonal spaces often lack (Efroymson et al.,

2009). Housing design contributes to psychological comfort by offering private and semi-private spaces that balance openness with privacy, encouraging both social interaction and personal retreat (Ahkami, 2023). Aesthetic, timeless design elements within housing and urban spaces not only enhance visual appeal but also strengthen residents' attachment to their surroundings (Hourakhsh Ahmad 2021). Incorporating aspirational elements, like community art or well-designed common spaces, adds character and meaning, inspiring pride and care for the neighbourhood. Together, thoughtful urban and housing designs that prioritize psychological comfort can encourage social cohesion, community pride, and satisfaction, ultimately contributing to a more resilient and harmonious urban fabric.

D. Sustainable Urban Housing Design

Developments must take into account environmental issues as well as sociocultural and socioeconomic livability elements in order to be effectively sustainable (Szibbo, 2015). In the context of sustainable urban housing, passive design principles, water management, energy management, solid waste management and sustainable transportation are essential for creating livable and environmentally sustainable communities. The absence of trees and soft paved surfaces in urban areas intensify the Urban Heat Island effect, which raises daytime temperatures, decreases nighttime cooling, and increases air pollution. These elements also contribute to a rise in heat-related diseases and fatalities (EPA, 2020). Due to climate change, the effects of heat stress on human health have increased within the past ten years (CDKN Global, 2021). In addition to this, the present-day aspirations of neo-rich and neo-urban people are ownership of a house, cars and expensive gadgets including air-conditioner and other energy guzzling devices. All these together not only impact the environmental quality, but are threats to long term sustainability of the city and livability factors for the people (Narayan, 2020). Moreover, these designs align with the goals of sustainable urban development by lowering greenhouse gas emissions and improving residents' quality of life. For example, cities with planned passive housing communities report reductions in energy costs and improved air quality within homes, which are critical aspects of livability (UN Habitat, 2012).

E. Challenges in Informal Settlements

While passive design principles contribute to the sustainability of planned housing, informal settlements face significant challenges in achieving similar standards. Literature indicates that informal housing, often constructed with substandard materials and lacking proper ventilation or insulation, struggles to provide thermal and visual comfort (UN Habitat, 2012). For instance, many informal settlements are built with materials that absorb and retain heat, creating uncomfortably warm indoor environments during summer months (Kumar, A., & Shukla, S. K. 2022). Additionally, the scarcity of green spaces and limited access to safe outdoor areas reduce opportunities for cooling, shade, and social interaction.

These conditions highlight the need for interventions that address both the physical and social dimensions of sustainability in informal settlements.

Scholars advocate for policies that support community-based upgrading efforts, such as retrofitting buildings with insulation and improving ventilation, which can enhance livability without displacing residents (Roy, 2016). Moreover, green infrastructure, such as planting trees and creating small community parks, can help to mitigate heat and provide residents with communal spaces. Initiatives like these are crucial for advancing sustainable urban housing in informal areas, contributing to both environmental resilience and improved quality of life.

III. Methodology

Seven broader parameters and their sub-parameters were defined based on the literature review to assess the various case studies of Housing in Pune City. These parameters were used to study the housing in these fourteen case studies. The survey was done through visual observations, mapping, surveys and interactions with the residents. These are-

A. Physiological Comfort Criteria

Literature suggests physiological comfort is central to livability, encompassing access to essentials like clean water, air, and food. The quality of thermal, visual, and environmental conditions in indoor and outdoor spaces, as well as walkability, sports, healthcare, and universal accessibility, significantly contribute to residents' health and well-being.

B. Psychological Comfort with the Built Environment

Psychological comfort, as noted in literature, arises from connection with nature and others, human-scaled spaces, and sociocultural engagement areas. Aesthetic, timeless design, and aspirational elements also enrich satisfaction, making places feel meaningful, enhancing residents' attachment to their surroundings, and encouraging community pride and interaction.

C. Economic Environment and Sustainability

A stable, sustainable economic environment supports livability by balancing affordable housing, economic opportunities, diverse businesses, and accessible educational infrastructure. Proximity to financial services also promotes security and economic inclusion. Together, these factors create a sustainable and promising economy that supports daily living and community stability.

D. Cultural Sustainability

Liveable spaces, as emphasized in literature, sustain cultural heritage by preserving traditions, practices, and identity. Infrastructure supporting cultural events and entertainment fosters a sense of belonging, enabling community members to engage in cultural practices and keep the locality's social fabric alive and resilient against change.

E. Quality of Life

Quality of life encompasses everyday conveniences, safety, and inclusivity. Literature suggests that reducing commute times, ensuring access to essential shopping, and promoting community safety enhance daily experiences. A liveable environment fosters inclusive spaces where diverse residents feel safe, included, and supported in their needs.

F. Environmental Sustainability

Environmental sustainability is vital for livability, focusing on eco-friendly construction, energy, water, and waste management practices. Sustainable transport options also lessen environmental impact. Literature stresses that these systems help maintain a balanced ecosystem, ensuring that the built environment remains conducive to human health and ecological resilience.

G. Resilience

Resilience, as described in literature, involves economic stability and disaster preparedness, equipping communities to face natural or health crises. A resilient economy, combined with readiness for emergencies, reinforces the community's ability to adapt, recover, and sustain long-term livability amidst various challenges and external pressures.

IV. Case Study Selection

The fourteen locations, 9 within the core city area and 5 towards outer limits of the city were selected for case studies to get a broader picture of housing scenario in the city. The varied typology has been selected to include the traditional housing, as well as the contemporary housing design. The selected case studies are as follows. First four are part of old city and core city area that include Wada and chawls, next three are the housing built in the decade of year 1990-2000. Next five case studies have been taken from towards the outermost circle, the next decade of year 2000-2020, and last three are the slums in three distinct parts of the city.

1. Indira Nagar Chawl, Pune
2. Dhere Wada, Pune
3. Wanjale Patil Wada, Pune
4. Natu chawl, Pune
5. Amarlata apartments, Hadapsar, Pune
6. Parijat Society, Bibvewadi, Pune
7. Le Royale Housing Society, Pune
8. Amanora - Future Tower, Pune
9. Marvel Sangriya, Pune
10. Mounstscape Cooperative Housing Society, Pune
11. Amanora Gateway Towers
12. Jedhepath slum, Pune
13. Slum rehabilitation Parvati, Pune
14. Prem Nagar, Market Yard, Pune

Figure 1 shows the map of Pune city and the locations of the case studies.

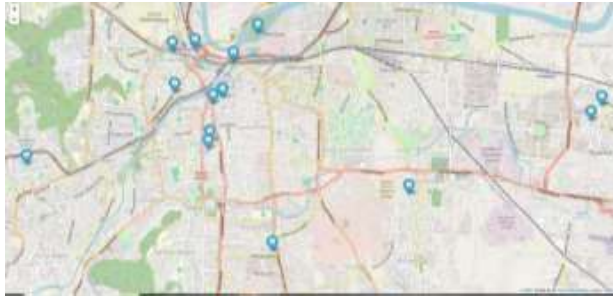


Figure 1: Locations of the case studies



Figure 2: Traditional typology: a. Wada, b. Chawl



Figure 3: Housing of the decade 1990-2000



Figure 4: Housing in the decade of 2000-2020 (a. affordable housing, Mounstscape at Undri, b. High-density High-end Housing, Amonora Future Towers



Figure 5: Slums and Slum rehabilitation

V. Format of Data Collection

The livability parameters as listed above were strategically divided into two categories to include detailed observations as well as the user point of view. Following tools were adopted to investigate these case studies.

- **Surveys and Interviews:** Conducted with residents to gather insights on water access, noise levels, thermal comfort, visual comfort, and satisfaction with green spaces.
- **Visual and Spatial Analysis:** Visual surveys, mapping, and sketches document housing layouts, green space quality, and access to amenities.
- **Comparative Analysis:** Each housing type is compared based on 7 defined parameters.

VI. Data Collection And Analysis

This section presents detailed findings on livability across the selected 14 case studies, categorized by key parameters. The survey was conducted amongst 97 respondents living in these 14 places. Following is the summarized analysis of the data collected through these surveys.

A. Physiological Comfort Criteria

The performance of housing in Pune in terms of offering physiological comfort varies significantly across different housing types, particularly in terms of water access, thermal comfort, visual comfort, air quality, and noise levels. Based on findings from various housing typologies in Pune, physiological comfort varies significantly due to differing approaches to building design. Traditional wadas and chawls utilize thick walls, central courtyards, and high ceilings, which allow passive cooling, ventilation, and natural light. The planned developments like Le Royale Housing Society and Mountscape Cooperative Housing Society feature advanced passive elements such as strategic orientation, high-performance glazing, and shaded balconies to enhance thermal comfort and energy efficiency. Projects like Amanora Future Towers and Marvel Sangria incorporate similar techniques, with deep overhangs, cross-ventilation, and green terraces to reduce solar heat gain and mitigate heat island effects.

Conversely, informal slum housing and some basic structures suffer from poor insulation, ventilation, and minimal passive design features, leading to uncomfortable temperature swings and reliance on fans or improvised shading. These variations reflect how design quality, material selection, and strategic planning impact residents' comfort levels across different housing types in Pune. Visual comfort varied depending on the housing type and its surroundings. Informal settlements like Prem Nagar had poor lighting due to cramped layouts and small windows, making artificial lighting essential. This lack of natural light, combined with visual clutter, negatively affected the quality of life. In contrast, planned housing complexes like Mountscape Cooperative Housing Society and Amanora Future Towers incorporated large windows, skylights, and reflective surfaces to maximize daylight, reducing the need for artificial lighting. Traditional designs in Natu Chawl relied on central courtyards for light, although narrow passages still required additional lighting. Planned housing exhibited enhanced visual comfort, while informal settlements suffered from insufficient lighting. Walkability and quality of open spaces significantly impact physiological comfort across Pune's diverse housing typologies, shaped by varying urban planning practices.

Traditional wadas maintain walkability. In chawls, high walkability arises from close proximity to essential services. Planned developments such as Amar Lata Apartments, Parijat Society, and Le Royale Housing Society enhance pedestrian experiences through strategic layouts, shaded paths, and proximity to amenities. Upscale complexes like Amanora Future Towers and Marvel Sangria emphasize pedestrian-friendly environments, incorporating shaded walkways, benches, and well-designed pathways. Contrastingly, informal settlements like the Market Yard Slum necessitate walkability for daily activities, though insufficient pedestrian infrastructure poses safety risks. Open spaces also differ markedly across typologies; planned housing such as Amanora Gateway Towers and upscale societies provide landscaped gardens and recreational areas supporting social interaction and wellness. Communal spaces in wadas and chawls, such as shrines or central courtyards, foster social cohesion. In informal settlements, open spaces serve multifunctional roles yet often lack organization, affecting usability.

B. Psychological Comfort

The survey of housing in Pune city highlights the impact of built environments on psychological comfort through diverse housing designs and their spatial arrangements. A primary factor influencing comfort is the connection to nature. In informal areas

like Market Yard slum, dedicated spaces for outdoor activities are scarce. Children play in streets, and while open spaces exist, they are often repurposed for vehicle parking, detracting from their potential as communal areas. Conversely, planned housing complexes like Amanora Future Towers offer extensive recreational facilities such as gyms, sports courts, and jogging tracks, supporting physical activity and a sense of community through shared spaces. Human-to-human connections also play a significant role in psychological comfort. In informal settings like Market Yard, despite limited resources, large trees and shared pathways act as natural gathering spots, fostering social interaction among residents. These informal "kattas" serve as community hubs, illustrating how even minimally designed spaces can promote interaction.

Planned developments like Sangria NIBM, however, demonstrate the added value of intentional design, with structured seating areas and landscaped public spaces encouraging socializing in aesthetically pleasing environments. The disparity between the spontaneous gathering in slums and the structured interactions in planned communities highlights the importance of design in facilitating community bonds. Aesthetic quality emerges as another determinant of psychological comfort. In Market Yard slum, narrow streets, poorly maintained brick houses, and infrastructural neglect, such as drainage leaks and haphazard electrical wiring, detract from the visual and livability standards, signaling a need for infrastructural improvements. Sangria NIBM and Amanora Gateway Towers, by contrast, feature contemporary and sustainable designs, blending functionality with elegance. Clean facades, green spaces, and energy-efficient systems create a visually calming environment, enhancing residents' sense of well-being and aligning with aspirations for modern living. Traditional areas like Kasba Peth maintain historical charm through vibrant courtyards, though they face challenges in balancing preservation with modern needs. These varied aesthetic experiences underscore the role of well-maintained and thoughtfully designed environments in enhancing residents' quality of life. Finally, the survey reveals the aspirations of Pune's residents regarding housing improvements. Around 60% of residents expressed satisfaction, citing comfort and community ties. However, 40% voiced desires for upgrades, including better parking, improved sanitation, and enhanced recreational amenities. Families often sought larger homes, better hygiene, and accessibility to essential services. Connectivity was also a prominent concern, with residents highlighting the need for proximity to schools, hospitals, and workplaces. These aspirations indicate a significant demand for housing that

incorporates larger spaces, modern infrastructure, and community-oriented facilities, particularly as urban density in Pune increases.

C. Economic Sustainability

The housing design in Pune contributes indirectly to economic sustainability by influencing affordability, access to diverse businesses, and the availability of essential amenities. Proximity to active economic hubs, like Market Yard and IT parks, provides residents with accessible job opportunities in various roles, such as loading goods, driving rickshaws, and providing domestic services. This proximity reduces commuting expenses and ensures steady income flow for many households, which is critical for sustaining local economic resilience. Having grocery stores, clothing shops, and repair services within walking distance also supports economic viability, lowering daily transportation costs and allowing families to allocate resources more efficiently. However, limitations persist due to the lack of high-quality employment options within immediate residential areas, forcing residents to travel to seek better-paying jobs.

The diversity of businesses in the area adds to its economic sustainability, though reliance on informal employment presents challenges. Local businesses support daily needs, but the nature of available jobs, which tend to be labor-intensive or service-oriented, limits economic development. This reliance on modest, often informal jobs meets short-term financial needs but provides limited long-term stability. Consequently, while the area offers immediate employment, residents struggle with job security, underscoring a need for varied and formalized employment opportunities to improve economic resilience. Affordability and access to educational amenities further influence stability. Proximity to schools and colleges is generally satisfactory, promoting easy commutes for children and encouraging family engagement in education. However, affordability is a concern, as rising tuition fees put a strain on low-income households striving to provide better opportunities for their children. Yet, some educational facilities lack quality infrastructure, leading to overcrowded classrooms and limited resources, which affects learning effectiveness. Though vocational training centers and skill development programs exist, awareness of these opportunities is low, pointing to a need for improved outreach to broaden residents' access to valuable skills training.

In summary, Pune's housing environment supports economic sustainability through accessible jobs and essential services, but gaps remain in quality employment, affordable education, and skill development.

D. Cultural Sustainability

Pune's diverse housing landscapes reflect a deep cultural foundation that sustains community bonds, traditions, and collective identity. In the Market Yard slum, residents build cultural resilience through close communal ties, despite infrastructural limitations and economic hardship. Festivals and gatherings are key aspects of daily life, strengthening community spirit and encouraging collective efforts toward neighborhood improvement. The informal setting, though constrained, nurtures a vibrant cultural environment where residents celebrate shared values, making these spaces essential to cultural sustainability.

In more planned housing towards the peripheral areas of the city- like the Mountscape Cooperative Housing in Undri Pisoli, design elements such as landscaped gardens and walkable pathways create spaces for social interactions and community engagement. These green areas embody a cultural appreciation for leisure and neighborly interaction, fostering a lifestyle where community activities and social gatherings become central.

However, these areas and other emerging neighborhoods, lack the historical permanence, identity and rich traditions that mark the identity of city's core areas. This distance from the city's historical and cultural heart results in a looser cultural identity, with fewer established community practices and weaker ties to Pune's cultural essence.

In contrast, in Shukrawar Peth's Mandai area, heritage plays a significant role in sustaining cultural relevance. Once a bustling trade center, Mandai still attracts residents and visitors, infusing the area with historical significance. Salunke Vihar exemplifies another facet of cultural sustainability, blending traditional and modern elements in its community spaces. With numerous temples, cafes, and parks, the area becomes a socio-cultural hub, supporting both spiritual and social gatherings. Local temples provide venues for religious and cultural events, enriching the social fabric and fostering a lively, interwoven community life. This balance of modern amenities and traditional gathering spaces enhances residents' connection to cultural roots, maintaining a sustainable social dynamic where spirituality and recreation coexist

Across Pune, the housing typologies showcase how physical environments can support cultural values and social resilience. Community-oriented designs in places like Salunke Vihar encourage interaction and leisure, while areas like Mandai emphasize heritage preservation. Together, these settings contribute to a sustainable cultural fabric, where heritage, community bonds, and shared traditions create resilience and continuity. By prioritizing spaces for socialization, spirituality, and tradition, Pune's housing typologies, especially in the core, contribute meaningfully to cultural sustainability, helping core neighborhoods retain a strong, enduring identity that the newer periphery areas are yet to develop.

E. Environmental Sustainability

Environmental sustainability in Pune's housing landscape faces challenges from air quality, traffic congestion, and a lack of pedestrian infrastructure, particularly in peripheral areas. One of the key issues in the outer regions is the reliance on private vehicles due to inadequate public transportation and a lack of walkable areas. This reliance leads to higher air pollution levels, as vehicles become the primary mode of transportation, contributing to poor air quality and increasing residents' health risks. An air quality analysis conducted across 78 spaces in 14 different housing case studies highlights significant variation in air quality index (AQI) levels across Pune. According to the World Health Organization (WHO), an AQI below 50 is ideal for healthy living, as it ensures clean air supportive of well-being. However, only 35 spaces out of these 78 spaces (44.9%) achieved this standard, providing residents with the health benefits of good air quality.

In contrast, 34 spaces (43.6%) showed AQI levels between 105 and 150. While these levels do not immediately endanger most residents, they pose risks to vulnerable groups such as children, the elderly, and individuals with respiratory issues, who may experience adverse health effects over prolonged exposure. The study revealed that 8 spaces (10.3%) exhibited AQI levels between 151 and 200, entering the "unhealthy" range, with potential effects on the general population. Alarmingly, 1 space recorded AQI between 201 and 300, categorized as "very unhealthy," where even healthy individuals may experience adverse effects. These findings indicate that nearly half of the spaces exceed the AQI threshold for liveable housing, underscoring an urgent need for environmental interventions to improve air quality. Additionally, noise pollution significantly impacts the sustainability of these housing environments. Noise levels in slum areas often exceeded WHO recommendations for liveable housing, with readings reaching up to 120 dB in

parking areas and 60 dB indoors. Even balconies frequently surpassed safe thresholds, leading to potential health issues such as stress and sleep disturbances. These findings stress the need for effective noise mitigation strategies in housing design to support healthier living environments, especially in high-density areas. Urban planning must prioritize sustainable transportation and green infrastructure, especially in outer residential areas, to mitigate pollution. The lack of walkable pathways and reliable public transportation options not only increases dependency on cars but also diminishes residents' quality of life. This issue is compounded by current landscape reservations in peripheral housing areas, where only 10% of the space is allocated for landscaping—a minimal allocation that fails to substantially improve environmental quality or provide effective green buffers against pollution.

Water management practices in Pune's housing sector face significant challenges to environmental sustainability. A concerning 70% of surveyed areas lack adequate wastewater management systems, which are crucial for preventing pollution. Additionally, 80% of housing developments do not utilize recycled water for flushing toilets or landscaping, missing opportunities to conserve water in a region where scarcity is a growing concern. The absence of effective storm water management practices is evident, with about 50% of areas failing to implement any systems to handle runoff, increasing risks of flooding and contamination. Moreover, rainwater harvesting systems are present in only 20% of housing projects, with 25% of these reported as non-functional.

In Pune, with its growing population and extensive urban spread, energy management in housing design plays a critical role in promoting environmental sustainability. Solar water heating systems, for instance, are installed in 42% of surveyed housing projects, yet only 35% are functional, leaving 7% in disrepair. A significant gap remains as 64% of projects do not have this system at all, indicating a missed opportunity for sustainable energy use. Similarly, energy-efficient outdoor lighting is present in 65% of projects, but 30% of these systems are non-functional, reducing their effectiveness. Solar-based outdoor lighting shows a similar pattern; though present in 56% of projects, half of these systems do not operate, highlighting a need for better maintenance. Notably, none of the surveyed projects generate their own energy, pointing to untapped potential for sustainable practices that could reduce the city's overall carbon footprint.

F. Solid Waste management

Solid waste management practices in Pune's housing projects highlight a mixed approach to sustainability. Waste segregation at source is adopted in 49% of projects, but 30% face challenges with residents not adhering to these systems, which limits their effectiveness. Notably, 21% of housing projects do not practice any waste segregation, leaving room for improvement in promoting environmentally conscious behaviors. Furthermore, none of the surveyed projects have implemented onsite organic waste management, missing a vital opportunity to reduce organic waste volume and create compost or other usable materials. E-waste management is particularly lacking, with only 7% of projects providing an e-waste management system, while 93% lack such facilities altogether. This data emphasizes the need for stronger systems, community participation, and maintenance practices in waste management across Pune's housing projects, reinforcing the importance of effective waste practices in achieving urban sustainability.

G. Quality of life

Limited space and substandard infrastructure contribute to lower living standards in densely populated neighborhoods, such as urban slums. The layout in these areas is typically cramped, with narrow streets and poorly maintained buildings that create a visually cluttered environment. Housing conditions often lack proper ventilation and privacy, while inadequate infrastructure—such as poorly managed electrical wiring and unreliable drainage systems—exacerbates safety concerns and inconveniences. These environmental conditions negatively impact residents' physical and mental well-being, highlighting the influence of infrastructure quality on overall livability. A survey revealed that while 64% of households received good-quality water, 30% dealt with hard water, and 6% had polluted supplies needing treatment. Water sufficiency is a notable issue, with 25% of respondents experiencing shortages. Monthly water expenses also varied; most spent under INR 2000, but 13% faced costs exceeding INR 3000 due to additional pumping or treatment needs. These variations highlight discrepancies in water quality, access, and financial burden among different housing typologies. Despite these challenges, slums often benefit from their proximity to local markets and nearby employment sectors, providing convenient access to economic opportunities. Such accessibility is crucial for low-income residents, as it supports livelihoods, even though job options are generally limited to labor-intensive roles. However, the absence of accessible and affordable education facilities or other public services limits opportunities for upward social and

economic mobility, which in turn affects long-term quality of life. Community resilience and strong social networks in these neighborhoods, however, help mitigate the lack of formal amenities; neighbors rely on each other for support and security, creating a close-knit social fabric that fosters a sense of safety within an otherwise challenging environment.

In contrast, modern residential complexes like Amanora Gateway Towers exemplify a different approach to urban quality of life, combining convenience, security, and aesthetic appeal through well-planned architectural design and efficient layout. These developments incorporate essential features such as power backup systems for common areas, ensuring uninterrupted access to elevators and utilities. Good ventilation, ample natural light, and a well-distributed layout enhance the indoor environment, promoting physical comfort and mental well-being. Additionally, these complexes often integrate green spaces and pedestrian-friendly pathways, contributing to a visually pleasing atmosphere that residents can enjoy. Recreational amenities like community halls, recreational zones, and central courtyards encourage social interaction, fostering a sense of community and belonging. However, these complexes also face challenges related to urban density. High population density and periodic congestion can disrupt the tranquility of these environments, impacting quality of life for residents who seek a quieter lifestyle. In terms of safety, modern housing layouts are often designed to facilitate natural surveillance through features like balconies, open courtyards, and strategically placed lighting in common areas. This “eyes on the street” approach enhances security, as residents are frequently visible in public spaces, adding a layer of vigilance that benefits both individual safety and community well-being.

H. Resilience

The resilience of housing in Pune City varies widely between informal areas, such as Market Yard slums, and formal developments like Amanora Gateway Towers, as reflected in environmental practices, medical infrastructure, connectivity, and governance. In terms of environmental stewardship, slums face challenges with informal waste management and insufficient water and sanitation facilities, which weaken resilience. Formal areas display more sustainable practices, with green spaces and regulated land use contributing to environmental health and reducing fragility. Medical infrastructure disparities are also prominent: slum residents often depend on distant, overcrowded healthcare facilities, while formal areas near healthcare hubs enjoy greater access to immediate and preventative care. This highlights a

need for expanded healthcare services in informal areas to bolster overall urban resilience. Telecommunications and physical connectivity differ significantly as well. Informal areas lack reliable internet and adequate public transportation, which restricts residents' social and economic mobility, while formal developments benefit from high-speed internet and dependable transportation, facilitating connectivity and enhancing quality of life. Improving infrastructure in slums would help mitigate these disparities, providing better access to services and opportunities.

Community governance reveals contrasting structures. Slums rely on community-driven, informal governance models that foster resilience within limited resources, whereas formal housing societies benefit from organized resident associations and structured development plans that support sustained improvement. Bridging these governance styles through collaborations among local authorities, residents, and NGOs could enhance resilience across all housing types, promoting inclusive and sustainable urban development. These findings suggest that a tailored approach addressing the unique needs of both informal and formal housing areas is essential to strengthening urban resilience throughout Pune.

VII. Conclusion

This study suggests implementation of the methodology and the findings of this study to conceive of a space diagram that can assist in evaluating livability factor of a scheme of design. The space diagram further may get decoded to address factors of site, infrastructure, spatial organization within the site, natural features, orientation, technology, people/density/ end users - in short to assist in conceiving an appropriate design satisfying criteria of livability. Diagrams may happen at conceptual stage, development stage, execution stage and may be able to handle different scales of spaces from site to cluster to interiors to a corner.

Improving livability in housing requires strategic policy framing and architectural design interventions. Affordable housing policies should incorporate infrastructure to ensure equitable development. Informal housing can benefit from sustainable, low-cost materials and decentralized infrastructure solutions like rainwater harvesting and solar panels, reducing costs while enhancing inclusive urban design and community-driven environmental resilience. Retrofitting policies can upgrade existing structures without full redevelopment, while zoning reforms should facilitate mixed-use developments, integrating residential and commercial functions. Architectural design must

prioritize green and community spaces, even in high-density areas, to support social interaction and well-being. Public transportation networks should be expanded to enhance accessibility to jobs, education, and healthcare. Community-driven infrastructure, supported by local governments and NGOs, can empower residents to actively contribute to the development and maintenance of their built environment, fostering long-term resilience and improved quality of life.

The study highlights disparities in housing conditions: planned residential complexes offer superior infrastructure, green spaces, and safety, whereas informal settlements exhibit strong social cohesion despite limited resources. Bridging this gap requires policies that support infrastructure enhancements tailored to resource-constrained environments. Decentralized solutions, such as community-managed water systems and local healthcare facilities, can significantly improve quality of life. Enhanced urban mobility through pedestrian-friendly pathways, public transit expansion, and last-mile connectivity will further support economic opportunities and accessibility.

Pune's peri-urban expansion seeks global standards but faces challenges in connectivity, sustainability, and architectural adaptability. Many developments are resource-intensive and require high maintenance, raising concerns about long-term viability. Shifting lifestyle preferences may lead to obsolescence in design, increasing demand for resource-intensive modifications. Additionally, declining air quality due to congestion and limited green spaces affects liveability. Integrating Pune's cultural identity into housing developments is crucial to maintaining architectural relevance while promoting sustainable living practices. A liveability framework based on planning and architectural principles should incorporate community spaces, green infrastructure, and adaptable layouts to transform resource-limited housing into resource-efficient environments. Modular housing designs in informal settlements can optimize land use, improve ventilation, and maximize natural lighting, addressing spatial constraints effectively. While formal housing ensures safety through cooperative societies and surveillance mechanism, informal settlements depend on strong social networks. Strengthening governance mechanisms with NGO and local authority support can formalize these community networks, enhancing security and maintenance efforts.

Advancing liveability in Pune's urban housing necessitates a comprehensive, policy-driven approach that integrates architectural innovation with strategic planning. By implementing sustainable practices and resident-focused policies, planners and architects can create a resilient, inclusive urban landscape, positioning Pune as a model for equitable and sustainable urban development.

Acknowledgment

We sincerely appreciate the efforts of 80 fourth-year B.Arch. students at SMEF's Brick School of Architecture for conducting case studies within the provided framework by us, as faculties of Urban Studies, has been invaluable in shaping our understanding of housing livability in Pune through their insightful findings.

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