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EXPLORING THE IMPACT OF INTERIOR DESIGN ON RESIDENTIAL SATISFACTION IN PREFABRICATED AFFORDABLE HOUSING

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ABSTRACT

This study explores the influence of interior design on residential satisfaction among residents of prefabricated affordable housing in Delhi, India. The research examines the relationships between three key design dimensions – Spatial Organization (SOR), Visual Elements (VEL), and Indoor Environmental Quality (IEQ) – and overall residential satisfaction (RSA). Findings based on structural equation modelling reveal that all three dimensions have significant positive impacts on RSA. However, Indoor Environmental Quality emerged as the strongest factor, followed by Spatial Organization. Visual Elements, while influential, held a slightly lesser weight in residents' overall satisfaction. These results suggest that residents prioritize practical considerations like thermal comfort, efficient layouts, and sufficient space for activities. This highlights the need for architects and designers to focus on Indoor Environmental Quality and Spatial Organization during the design of prefabricated affordable housing. Careful material selection with low chemical emissions and space-saving solutions are crucial for resident well-being. In conclusion, this research underscores the importance of considering all aspects of interior design to enhance residential satisfaction in affordable housing. Prioritizing Indoor Environmental Quality and Spatial Organization, alongside mindful material selection, can contribute significantly to resident well-being within these dwellings.

Keywords: Interior Design, Aesthetics, Spatial Organization, Indoor Environment Quality, Occupants' Well-Being, Residential Satisfaction

1. INTRODUCTION

Prefabricated construction technology (PCT) offers a promising solution to the growing need for affordable housing, often prioritizing functionality, cost-effectiveness, and sustainability. It is considered a nascent technological innovation in the construction sector as a smart technology that is replacing conventional methods. PCT is an innovative smart technology that involves making the components or modules of a structure or building in the manufacturing plants under controlled conditions and transporting the ready-to-use components or sub-components for fitting them together on the construction site where the building has to be built (Jiang et al., 2019; Jain & Bhandari, 2022).

The affordable housing projects surveyed in this study were constructed using prefabricated construction technology (PCT) by B.G. Shirke Construction

Technology Private Limited (BGSCTPL). The specific construction method employed was the 3-S technology, which emphasizes quality control and efficiency. All structural components in these projects are composed of reinforced cement concrete, pre-engineered and manufactured in factories. This approach ensures high standards of quality and durability. Additionally, the infill walls were constructed using fly ash bricks, further enhancing the sustainability and overall performance of the housing units (Singh and Naskar, 2020). However, beyond the practical benefits, it is essential to consider the residential satisfaction of occupants in prefabricated affordable housing. Understanding the well-being and contentment of residents is crucial for making informed decisions in future housing projects, ensuring that these dwellings not only meet functional and economic criteria but also promote a high quality of life.

Residential satisfaction is an important aspect of quality of life, and it has been extensively studied in various contexts. It measures the difference between the present conditions and the desired conditions of the housing and neighbourhood environment from the perspective of the residents (Galster & Hesser, 1981). Salleh (2008) defined Residential satisfaction as the degree to which an individual's housing needs are satisfied. Hui & Yu (2009) stated that Residential satisfaction is a reflection of the degree to which the inhabitants feel that their housing is helping them to achieve their goals. Residential satisfaction refers to individuals' evaluation of the conditions of their current residential environment, subject to their needs, expectations and achievements.

Residential satisfaction is not only important for individuals' well-being but also has implications for predicting life satisfaction, measuring quality of life, and evaluating housing projects (Addo, 2015). Pinquart & Burmedi (2003) suggested that Residential satisfaction can be divided into three aspects: housing satisfaction, neighbourhood satisfaction & community satisfaction. Buys & Miller (2012) argue that the majority of researchers have only focused on any one of the three aspects of residential satisfaction with an extensive focus on neighbourhood satisfaction and less focus on satisfaction at the level of dwelling unit (Aigbavboa & Thwala, 2016). Most of the time, the quality of the building and dwelling unit lead to post-occupancy dissatisfaction because of building defects, high maintenance costs, poor indoor environment quality, less functionality, durability, poor services, poor fittings, substandard materials, poor aesthetics and poor workmanship (Deuble & de Dear, 2014). Galster (1985) argued that to enhance their satisfaction level individuals always give priority to their dwelling unit irrespective of which dimensions of residential satisfaction cause the dissatisfaction most.

Interior design plays a critical role in improving and ensuring the quality of the dwelling unit. It goes beyond just enhancing the aesthetics and it also contributes to the overall indoor environment quality and functionality of the dwelling unit, impacting the health and wellbeing of the occupants (Bluyssen, 2009). Studies suggested that an average person spent most of the time indoors (>90%) and 80 % of indoor time spent within the dwelling unit (de Kluizenaar et al., 2017). This emphasizes the critical importance of prioritizing the Interior design to provide a healthy indoor environment for the occupants. Hence, this research aims to explore the influence of interior design on the residential satisfaction of occupants by undertaking the following objectives.

- To develop a conceptual framework representing the nexus between components of interior design and residential satisfaction.
- To check the reliability and validity of identified components.

- To analyze the relationships between the components through structural equation modelling.

2. LITERATURE REVIEW

A well-designed dwelling unit not only provides shelter to its occupants but also fosters a sense of comfort, well-being & satisfaction. Interior design plays an important role in this accomplishment by influencing the perception and experiences of the occupants (Bluyssen, 2009). A review of the relevant literature (Table 1) on the subject suggests various factors of interior design that influence the residential satisfaction of the occupants. A conceptual framework (Figure 1) of this study can be proposed by grouping these components into three general categories: Spatial Organization (SOR), Visual Elements (VEL) and Indoor Environment Quality (IEQ). By considering these factors of interior design, architects and designers can create dwelling units that promote a sense of comfort, functionality, and overall residential satisfaction.

Figure 1

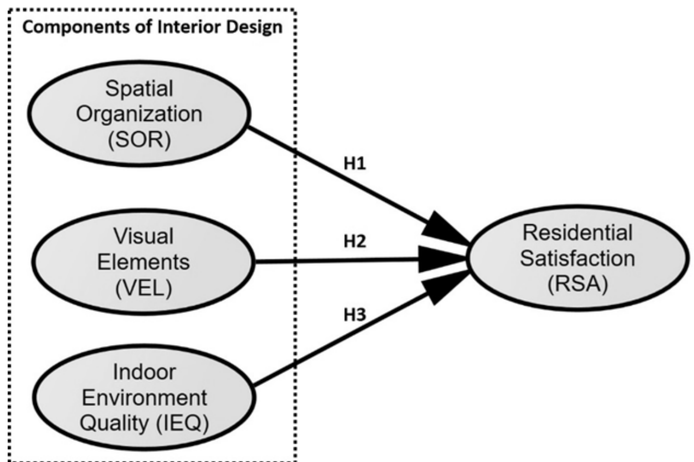

Figure 1 Conceptual Framework of Study

2.1. SPATIAL ORGANIZATION

Residential satisfaction is significantly influenced by the spatial organization of the dwelling unit which encompasses several key factors. A study (Mohammadi et al., 2014) suggested that the overall layout refers to the arrangement of rooms and their connection to each other. A well-designed layout promotes a sense of flow, visual privacy and a healthy indoor environment by avoiding awkward & unhygienic transitions. A well-organized layout promotes functional efficiency, where residents can navigate seamlessly between activities. Ease of circulation, achieved through thoughtful furniture placement and clear door-opening relations, further enhances this efficiency and reduces feelings of frustration (Xu et al., 2021). Finally, sufficient space allocation for various activities, including adequate storage solutions, fosters a sense of order and reduces clutter, contributing positively to overall residential satisfaction (Dinç et al., 2014).

2.2. VISUAL ELEMENTS

Visual elements play a significant role in shaping resident satisfaction within a dwelling unit. Texture and colour palette significantly influence the perceived spaciousness and mood of the interior. The strategic use of lighter colours and varied textures can create a sense of openness, while darker tones or a monotonous texture scheme can evoke a feeling of confinement (Yildirim et al., 2007). Daylight is another crucial factor, impacting not only visual comfort but also resident well-being. Maximizing natural light through appropriate window placement and minimizing obstructions enhances occupant mood and reduces reliance on artificial lighting (Xue et al., 2014). Speaking of artificial lighting, a well-designed lighting scheme with proper task and ambient lighting creates a sense of visual comfort and caters to diverse activities within the dwelling (Sholanke et al., 2021). Finally, the design aesthetics of interior components, including furniture, fixtures, and finishes, contribute to the overall visual appeal of the space (Lee et al., 2017).

2.3. INDOOR ENVIRONMENT QUALITY

Indoor environmental quality (IEQ), highly dependent on the selection of the interior material, significantly impacts residential satisfaction. Acoustic comfort, a key aspect of IEQ, is influenced by the selection of building materials. Utilizing sound-absorbing materials like mineral wool or recycled cotton insulation can lessen noise pollution, promoting a more tranquil living environment (Vardaxis et al., 2018). Similarly, air quality is directly affected by material selection. Opting for low-volatile organic compound (VOC) emitting materials, minimizes exposure to harmful airborne pollutants and unpleasant odours, enhancing occupant well-being (Yang et al., 2020). Thermal comfort, another crucial factor in IEQ, can be improved through material choices. Strategic use of insulating materials and incorporating natural ventilation strategies can contribute to maintaining a comfortable indoor temperature, reducing reliance on energy-intensive heating and cooling systems (Latha et al., 2015). Furthermore, proper building design and material selection play a vital role in mitigating dampness issues. Dampness can not only lead to structural deterioration but also foster the growth of mould and mildew, potentially triggering respiratory problems and allergic reactions (Loftness et al., 2007). By prioritizing materials and design strategies that address these aspects of IEQ, residential environments can be optimized to promote occupant satisfaction, health, and well-being.

2.4. RESIDENTIAL SATISFACTION

Residential satisfaction is a multifaceted concept encompassing not only overall contentment with one's dwelling but also influencing residents' decisions regarding their living situation. It manifests in various ways, including overall satisfaction with the dwelling and its surroundings (Mohit & Raja, 2014). High residential satisfaction is often correlated with a resident's intention to remain in their current home (Speare, 1974). Furthermore, satisfied residents are more likely to recommend their neighbourhood or dwelling to others (Galster, 1985). Therefore, understanding the factors that influence residential satisfaction is crucial for various stakeholders, including policymakers and developers, as it can inform decisions that enhance resident well-being and promote community stability.

Table 1

Table 1 Items Used for Conceptual Framework

Constructs	Code	Indicators	References
Spatial Organization	SOR 1	Overall Layout	(Mohammadi et al., 2014)

(SOR)	SOR 2	Ease of Circulation	(Xu et al., 2021)
	SOR 3	Enough Space for various activities	(Dinç et al., 2014)
Visual Elements	VEL 1	Texture and Colour Palette	(Yildirim et al., 2007)
(VEL)	VEL 2	Day Lighting	(Xue et al., 2014)
	VEL 3	Artificial Lighting	(Sholanke et al., 2021)
	VEL 4	Design aesthetics of interior components	(Lee et al., 2017)
Indoor Environment Quality	IEQ 1	Acoustic Comfort	(Vardaxis et al., 2018)
(IEQ)	IEQ 2	Air quality	(Yang et al., 2020)
	IEQ 3	Thermal Comfort	(Latha et al., 2015)
	IEQ 4	Dampness	(Loftness et al., 2007)
Residential Satisfaction	RSA 1	Overall Satisfaction	(Mohit & Raja, 2014)
(RSA)	RSA 2	Staying Intention	(Speare, 1974)
	RSA 3	Living Recommendation	(Galster, 1985)

Source Author’s compilation

2.5. RESIDENTIAL SATISFACTION

Residential satisfaction is a multifaceted concept encompassing not only overall contentment with one's dwelling but also influencing residents' decisions regarding their living situation. It manifests in various ways, including overall satisfaction with the dwelling and its surroundings (Mohit & Raja, 2014). High residential satisfaction is often correlated with a resident's intention to remain in their current home (Speare, 1974). Furthermore, satisfied residents are more likely to recommend their neighbourhood or dwelling to others (Galster, 1985). Therefore, understanding the factors that influence residential satisfaction is crucial for various stakeholders, including policymakers and developers, as it can inform decisions that enhance resident well-being and promote community stability.

2.6. HYPOTHESIS DEVELOPMENT

The hypothesis is a testable statement resulting from the theory on which the conceptual model is based. By testing the hypothesis, it is expected that a solution could be found for the problem encountered. Based on the above discussion, three hypotheses were proposed as shown in Figure 1.

H1. Residential Satisfaction (RSA) is positively impacted by Spatial Organisation (SOR)

H2. Residential Satisfaction (RSA) is positively impacted by Visual Elements (VEL)

H3. Residential Satisfaction (RSA) is positively impacted by Indoor Environment Quality (IEQ).

3. METHODOLOGY

This study adopts a quantitative approach through a survey design to empirically analyse the proposed conceptual framework shown in Figure 1. A survey questionnaire was developed to capture the satisfaction level of occupants. The questionnaire utilized a 5-point Likert scale ranging from 1 (highly dissatisfied) to 5 (highly satisfied). A random sample of 250 residents was recruited from prefabricated affordable housing units in Rohini, Narela, and Dwarka, Delhi. After checking the reliability and validity of proposed constructs through the measurement model all constructs were placed into the proposed conceptual model to analyse the relationships between the components of interior design and residential satisfaction through Structural Equation Modelling (SEM). SEM is a multivariate statistical technique particularly suited for exploratory research as it allows for the examination of complex relationships between variables (Hair et al., 2016).

4. RESULTS

The statistical analysis tools SPSS 23.0 and AMOS 21.0 were used to analyse the data collected through a questionnaire survey. The reliability of questionnaires was tested by Cronbach's alpha coefficient and found appropriate as specified followed by a confirmatory factor analysis (CFA). It is a multivariate statistical procedure used to assess the representativeness of the measured variables of the associated constructs, serving as the initial step in various Structural Equation Models (SEMs). CFA comprises of two steps, the first is analysis of measurement model (Figure 2) and second is analysis of structural model (Figure 3). The measurement model examines the composite reliability, discriminant and convergent validity, along with model fit indices. On the other hand, the structural model explains the causal relationships between the various constructs of the conceptual model (Hair et al., 2016).

4.1. MEASUREMENT MODEL - MODEL FIT, RELIABILITY AND VALIDITY

According to Table 2, all of the indices achieved the standard value within the specified range (Kline, 2005; Marsh & Grayson, 1995; Marsh & Hocevar, 1985) when all components were put together in the measurement model. Thus, the model fitted the data effectively. According to Table 3, regression weights and co-variances among the factors were significant and p value does not exceeding the threshold limit ($p < 0.001$). Thus, further re-specification of the model was not required.

The analysis based on Table 4 revealed strong evidence for the measurement model's reliability and validity (Hair et al., 2016). Composite reliability (CR) exceeded 0.70 for all constructs, indicating that the measures consistently capture the underlying latent variables. Convergent validity was also established, as the average variance extracted (AVE) for each construct surpassed 0.50 and fell below its corresponding CR value. This suggests that the measures share a substantial amount of variance with their intended construct, but not too much variance with other constructs. Finally, the analysis achieved discriminant validity based on two complementary pieces of evidence.

First, the maximum shared squared variance (MSV) remained lower than the average variance extracted (AVE) for all constructs. Second, the square root of AVE for each construct exceeded the correlation between that construct and any other construct in the model, following the Fornell-Larcker criterion. Together, these findings indicate that the measures are better at explaining their latent variables compared to other variables in the model, thus supporting discriminant validity.

Figure 2

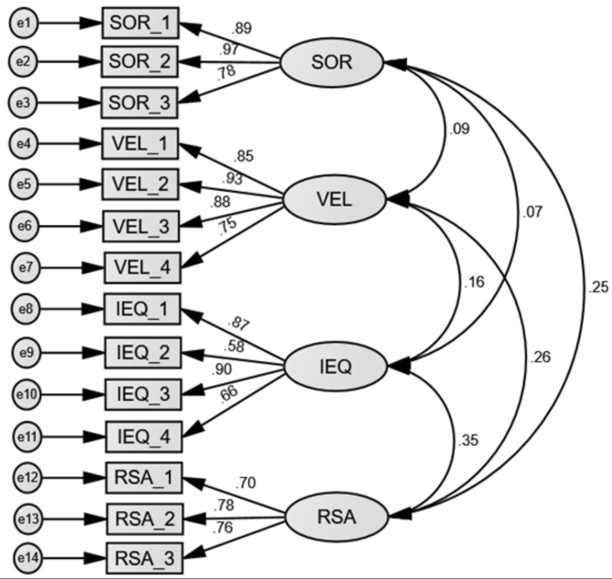

Figure 2 Measurement Model

Table 2

Table 2 Result of Model Fit Indices: Measurement Model

Model Fitness indices	Values	References
CMIN/DF	2.400	≤ 4.00 (Marsh and Hocevar, 1985)
GFI	0.907	≥ 0.80 (Marsh and Hocevar, 1985)
AGFI	0.862	≥ 0.70 (Kline, 2005)
CFI	0.952	≥ 0.80 (Kline, 2005)
PRATIO	0.780	≥ 0.50 (Marsh and Grayson, 1995)
PNFI	0.718	≥ 0.50 (Marsh and Grayson, 1995)
PCFI	0.743	≥ 0.50 (Marsh and Grayson, 1995)
RMSEA	0.075	≤ 0.08 (Kline, 2005)
SRMR	0.063	≤ 0.10 (Kline, 2005)

Source Author's compilation, Computed in AMOS-21.0

Table 3

Table 3 Standardized Regression Weights: Measurement Model

	S.E.	C.R.	Factor Loading	P
SOR_1 <--- SOR	0.070	15.812	0.887	***
SOR_2 <--- SOR	0.074	16.447	0.968	***
SOR_3 <--- SOR			0.776	
VEL_1 <--- VEL	0.074	13.907	0.852	***
VEL_2 <--- VEL	0.082	15.172	0.929	***
VEL_3 <--- VEL	0.078	14.406	0.880	***
VEL_4 <--- VEL			0.746	

IEQ_1 <--- IEQ	0.104	11.312	0.872	***
IEQ_2 <--- IEQ	0.103	8.166	0.580	***
IEQ_3 <--- IEQ	0.111	11.404	0.897	***
IEQ_4 <--- IEQ			0.657	
RSA_1 <--- RSA	0.105	9.527	0.698	***
RSA_2 <--- RSA	0.115	10.005	0.783	***
RSA_3 <--- RSA			0.761	

Source Author's compilation, Computed in AMOS-21.0

Table 4

Table 4 Reliability & validity: Measurement Model

	CR	AVE	MSV	SOR	VEL	IEQ	RSA
SOR	0.911	0.775	0.065	**0.880**			
VEL	0.915	0.730	0.067	0.088	**0.854**		
IEQ	0.844	0.583	0.125	0.067	0.156	**0.764**	
RSA	0.792	0.560	0.125	0.255	0.260	0.354	**0.748**

Source Author's compilation, Computed in AMOS-21.0

4.2. STRUCTURAL MODEL - MODEL FIT & HYPOTHESIS TESTING

To analyse the proposed hypothesises, the conceptual model (Figure 3) was developed in AMOS 21.0 with the 03 variables of SOR, 04 variables of VEL, 04 variables of IEQ and 03 variables of RSA. Further the model was tested using the maximum likelihood method. The model fit indices were calculated and found within the specified range, including CMIN/df = 2.403, GFI = 0.904, AGFI = 0.863, CFI = 0.950, PRATIO = 0.813, PNFI = 0.746, PCFI = 0.772, RMSEA = 0.075, SRMR = 0.083, Thus, the model fitted the data effectively and further re-specification of the model was not required.

Table 5

Table 5 Structural Model Analysis

Hypothesis	Relationship	Standardized Estimates (b)	S. Error	C.R.	p-values	Decision
H1	RSA <--- SOR	0.224	0.058	3.196	0.001	Supported
H2	RSA <--- VEL	0.202	0.062	2.860	0.004	Supported
H3	RSA <--- IEQ	0.315	0.095	4.143	***	Supported
Squared Multiple Correlations R^2 = 0.190						
Note: *** (p < 0.01), ** (p < 0.05), * (p > 0.05)						

Source Author's compilation, Computed in AMOS-21.0

The study assessed the impact of three constructs on Residential satisfaction (Table 5). The impact of Spatial Organisation on Residential satisfaction (H1: RES <--- SOR) was found positive and significant (b= 0.224, CR = 3.196, p = 0.001), hence H1 was supported. The impact of Visual Elements on Residential satisfaction (H2: RES <--- VEL) was found positive and significant (b= 0.202, CR = 2.860, p = 0.004), hence H2 was supported. The impact of Indoor Environment Quality on Residential satisfaction (H3: RES <--- IEQ) was found positive and significant (b= 0.315, CR = 4.143, p < 0.001), hence H3 was supported.

Figure 3

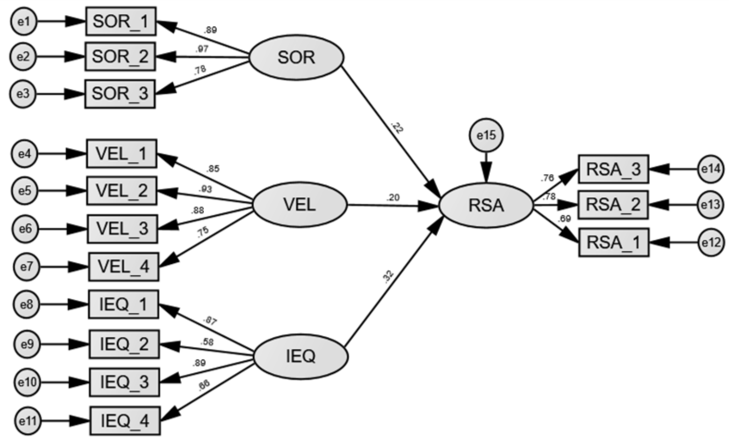

Figure 3 Structural Model

5. DISCUSSION

This study explored the impact of interior design on residential satisfaction among residents of prefabricated affordable housing in Rohini, Narela, and Dwarka, Delhi. The findings support the hypotheses that all three dimensions of interior design – Spatial Organization (SOR), Visual Elements (VEL), and Indoor Environmental Quality (IEQ) – have positive and significant relationships with Residential Satisfaction (RSA).

The strongest positive influence was observed for Indoor Environmental Quality (IEQ) ($\beta = 0.315$, CR = 4.143, $p < 0.001$). This suggests that factors like thermal comfort, acoustic control, air quality, and dampness play a crucial role in shaping residents' overall satisfaction with their living space. This aligns with previous research highlighting the importance of a healthy and comfortable indoor environment for occupant well-being and overall satisfaction (Latha et al., 2015; Loftness et al., 2007; Vardaxis et al., 2018; Yang et al., 2020).

Spatial Organization (SOR) also emerged as a significant factor ($\beta = 0.224$, CR = 3.196, $p = 0.001$). Residents valued aspects like efficient layouts, ease of movement within the space, and having sufficient space for desired activities. This finding resonates with studies that emphasize the importance of functional layouts that cater to residents' needs and promote a sense of spaciousness in often compact prefabricated dwellings (Dinç et al., 2014; Mohammadi et al., 2014; Xu et al., 2021).

Visual Elements (VEL) exerted a positive influence on residential satisfaction ($\beta = 0.202$, CR = 2.860, $p = 0.004$). The interplay of texture, colour palettes, daylighting, artificial lighting, and the aesthetics of interior components contributed to a more positive perception of the living space. This aligns with research suggesting that visual elements can significantly impact residents' emotional responses and overall well-being within their homes (Lee et al., 2017; Sholanke et al., 2021; Xue et al., 2014; Yildirim et al., 2007)

6. CONCLUSION

This study contributes to the understanding of how interior design influences residential satisfaction in prefabricated affordable housing. The findings highlight the importance of all three dimensions – Spatial Organization, Visual Elements, and Indoor Environmental Quality – in shaping residents' perceptions of their living space. By prioritizing these aspects, with a particular focus on IEQ and SOR during design and construction, policymakers and developers can create dwellings that promote not only affordability but also resident well-being and satisfaction.

Interestingly, the study suggests that residents prioritized Indoor Environmental Quality (IEQ) and Spatial Organization (SOR) more than Visual Elements (VEL) in terms of their overall satisfaction. This highlights the importance for architects and designers to give more weight to IEQ and SOR during the design process of prefabricated affordable housing projects. Prioritizing these aspects can ensure that basic needs for comfort, health, and functionality are met, which residents value most highly.

Furthermore, careful consideration should be given when selecting materials for interior design. The chemical properties of these materials significantly impact indoor air quality, and their shape, size, and installation techniques influence space optimization. Choosing low-VOC (volatile organic compound) emitting materials, maximizing natural light penetration, and employing space-saving furniture and storage solutions can all contribute to a healthy and well-organized living environment.

The initial study's limitations call for broader research. Future investigations should include a more diverse sample across various locations and housing types, moving beyond the initial focus on prefabricated affordable housing. Additionally, considering residents' cultural backgrounds and design preferences would enrich the understanding of how these factors influence residential satisfaction. One promising direction involves a deeper examination of specific aspects within the identified dimensions. For example, research could explore the optimal amount of natural light or preferred colour schemes to maximize well-being within prefabricated housing.

Furthermore, incorporating co-design processes with residents would offer invaluable insights into user preferences and inform the design of future affordable housing projects. Beyond subjective resident satisfaction surveys, future studies could benefit from employing objective measurement tools. Utilizing specific instruments to measure temperature and humidity would allow researchers to validate thermal comfort within a given climatic zone. This combined approach, using both subjective and objective data, would provide a more comprehensive picture of how interior design elements influence residential satisfaction.

CONFLICT OF INTERESTS

None.

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None.

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