Primljen / Received: 9.8.2024.
Ispravljen / Corrected: 11.12.2024.
Prihvaćen / Accepted: 16.1.2025.
Dostupno online / Available online: 10.4.2025.

User satisfaction in multi-storey energy-efficient housing: Implementation of an evaluation model

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Research Paper

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User satisfaction in multi-storey energy-efficient housing: Implementation of an evaluation model

User satisfaction with housing plays an important role in improving the quality of life of individuals and sustainable building designs. Measuring user satisfaction is a crucial tool for assessing the suitability of housing to meet user needs and expectations. In this context, assessing user satisfaction with energy-efficient housing is of great importance in terms of both saving energy and increasing comfort. The study aimed to evaluate user satisfaction with a multistorey energy-efficient housing project by using a user satisfaction model in energy-efficient dwellings. The application and testing of the model in a residential project constitutes the unique value of this study. The model was applied to the users of a multistorey housing project in Istanbul through a questionnaire survey. The effects of energy-efficient building elements and insulation, heating, and cooling systems on user satisfaction were evaluated. User satisfaction was evaluated through the themes of comfort conditions, dwelling–environment relationships, health, and system characteristics and service features. The comparison of all themes indicated that 'health' had the lowest satisfaction level owing to insufficient operable windows, limited natural ventilation, and humidity regulation issues, which likely contributed to upper respiratory tract complaints. This study provides important implications for the design of energy-efficient dwellings and for meeting user expectations.

Key words:

energy efficiency, multistorey housing, sustainable building design, user satisfaction

Prethodno priopćenje

Gökhan Uşma

Zadovoljstvo korisnika u energetski učinkovitim višekatnicama: Implementacija evaluacijskog modela

Zadovoljstvo korisnika stanovanjem igra važnu ulogu u poboljšanju kvalitete života pojedinaca i održivog projektiranja zgrada. Mjerenje zadovoljstva korisnika ključan je alat za procjenu prikladnosti stanovanja kako bi se zadovoljile potrebe i očekivanja korisnika. U tom kontekstu procjena zadovoljstva korisnika energetski učinkovitim stanovanjem od velike je važnosti kako za uštedu energije tako i za povećanje udobnosti. Cilj je istraživanja procijeniti zadovoljstvo korisnika energetski učinkovitom višestambenom zgradom primjenom modela zadovoljstva korisnika u energetski učinkovitim stanovima. Primjena i testiranje modela u stambenom projektu jedinstvena je vrijednost ovog istraživanja. Model je primijenjen na korisnike višestambene zgrade u Istanbulu putem anketnog upitnika. Procijenjeni su učinci energetski učinkovitih građevinskih elemenata te sustava toplinske izolacije, grijanja i hlađenja na zadovoljstvo korisnika. Zadovoljstvo korisnika ocjenjivano je kroz udobnost, odnose između stana i okoline, zdravlje te karakteristike sustava i značajke usluge. Usporedba svih područja ispitivanja pokazala je da je "zdravlje" imalo najnižu razinu zadovoljstva zbog nedovoljno prozora, ograničene prirodne ventilacije i problema s regulacijom vlage, što je vjerojatno pridonijelo tegobama gornjih dišnih puteva. Ovaj rad pruža važne smjernice za projektiranje energetski učinkovitih stanova i ispunjavanje očekivanja korisnika.

Ključne riječi:

energetska učinkovitost, višekatnice, održivi projekt zgrade, zadovoljstvo korisnika

1. Introduction

In the literature, user satisfaction is the result of users' experience of usability [1]. Magalhaes mentions that generally two concepts of user satisfaction exist based on different approaches. The process-oriented approach considers user satisfaction as the difference between expected and achieved satisfaction, whereas the outcome-oriented approach considers user satisfaction as a feature extracted from a system, product, or service after use [2].

Residential user satisfaction is defined as an attitude that depends on the residential environment. Given the different attitude components (knowledge, emotion, and behaviour) proposed by Rosenberg and Hovland, some researchers prefer emotional components to define residential user satisfaction, while others prefer perception-based definitions [3]. In definitions where an affective component is significant, residential occupant satisfaction means projecting feelings of satisfaction and happiness onto the dwelling [4, 5]. In definitions where an informational component is important, occupant satisfaction with their housing depends on the size of the gap between current conditions and the standards they expect and demand [6-8]. In the informative approach, Bardo and Hughey [9], Canter and Rees [10], and Morrissy and Handal [11] argued that user satisfaction with housing increases as the gap between the current situation and demands and needs decreases.

Rapoport stated that people prefer environments that are suitable for their psychological and social needs [12]. In this context, housing choice is influenced by household, house type, size, life cycle stage, structure, social class, education, current occupation, household income, neighbourhood/location, and housing expenditure norms [13]. Living standards, quality improvements, and social performance must be consistent with household aspirations [14]. User satisfaction, as an indicator of individual well-being, plays an important role in the quality of life [15]. Satisfaction encourages users to enter and remain in housing. By contrast, low satisfaction encourages users to search for new housing [16]. Studies show that a number of variables related to housing and its environment, including the socio-demographic characteristics of the occupants, have a significant impact on the level of satisfaction with housing and are related to culture and values. This highlights the importance of evaluating housing satisfaction through user experience and feedback.

Energy efficiency in buildings is important for reducing energy costs, minimising environmental impacts by decreasing fossil fuel consumption, and achieving sustainable urbanisation goals. In this context, the literature defines energy-efficient buildings as structures designed based on sustainable principles that maintain minimal energy consumption while preserving user comfort and building functionality [17-20]]. Accordingly, this study aimed to evaluate user satisfaction within the framework of energy-efficient housing.

2. Indicators of residential satisfaction: insights from recent studies

Residential satisfaction is a multidimensional concept influenced by various physical, social, economic, and environmental factors. Numerous studies have examined these dimensions to understand how different dwelling attributes and their surroundings shape user experiences and satisfaction levels. By exploring these factors through user-centred approaches, researchers aim to uncover the key elements that contribute to a better quality of life in residential environments. This section reviews the significant contributions from the literature, highlighting diverse perspectives and criteria for evaluating residential user satisfaction.

Somiah et al. identified key factors influencing user satisfaction in residential settings, including building quality, social dynamics, neighbourhood attributes, management practices, and the specific features of the residential unit [21]. Similarly, Gündoğdu et al. explored user satisfaction in dwellings by categorising it into two primary aspects: satisfaction with the dwelling itself and satisfaction with its surrounding environment. Dwelling satisfaction was assessed using criteria such as location, size, interior design, functionality, usability, indoor comfort (including sunlight, ventilation, and insulation), exterior aesthetics, and landscaping. Environmental satisfaction was evaluated based on factors such as building spacing, street width, privacy, sun exposure of buildings, availability of green spaces and playgrounds, parking facilities, safety of vehicles, housing security, neighbourhood relations, accessibility to the city centre, educational institutions, healthcare services, open spaces, entertainment venues, shopping areas, and public transport stops [22].

Jiang et al. [23] classified user satisfaction in residential contexts into three main dimensions: housing, living environment, and neighbourhood. Housing dimensions comprise indicators such as floor area, dwelling size, and number of bedrooms. The living environment dimension includes proximity to facilities such as primary schools, retail stores, malls, healthcare centres, recreational spaces, metro stations, and bus stops. Finally, the neighbourhood dimension encompasses factors such as commuting time, number of stores, frequency of interactions with neighbours, familiarity with neighbours, involvement in community activities, and participation in self-organised or management-related events.

Sirgy [24] categorises residential satisfaction into three main dimensions. The physical dimension includes crowding, noise levels, lighting, environmental quality, and scenery; the social dimension includes interactions with neighbours, communal spaces, relationships with others, and privacy within the home; and the economic dimension is defined by the property value within the neighbourhood, living costs, and the socioeconomic profile of the area. Gür and Dostoğlu [25] identify satisfaction criteria as including social facilities, open spaces, environmental attributes, physical aspects of the dwelling, accessibility and transportation, safety, climate control within the dwelling, and

relationships within the neighbourhood. Forte and Russo [26] divided the factors influencing residential user satisfaction into three quality groups to assess their impact on quality of life: open spaces, shared indoor spaces, and the housing unit. Similarly, Al-Homoud and Is-Haqat [27] grouped indicators affecting residential satisfaction into seven categories: project location, dwelling design, overall project design, financial considerations, infrastructure, environmental concerns, and social dynamics. Barutçular and Dostoğlu [28] examined user satisfaction factors across six dimensions; namely, location, views, site advantages, green spaces (gardens), neighbourhood relations, and family unity.

In summary, the existing literature underscores the multifaceted nature of residential user satisfaction shaped by physical, social, economic, and environmental factors. Understanding these elements through user feedback offers valuable insights for the design and management of liveable and user-centred residential environments.

3. Materials and methods

3.1. Energy-efficient features of the housing project

The residential building considered in this study is located in the Şişli district of Istanbul, Turkey, in a densely populated area where the main arteries of the city intersect. The locations of residential buildings, surrounding transport axes, and important points are shown in Figure 1. The building has 46 floors: 34 residential floors, three penthouse floors, three office floors, two technical and social floors, and four parking floors. The project has 5,600 m^2 of green space. Linden, redbud, and rosebud trees, which require the least amount of water, were selected for landscaping [29]. The building has an area of 9,000 m^2 and double-skin façades designed to be intertwined. These facades were intended to provide an insulating layer within the building. The building has internal courtyards and gardens, walking tracks, bicycle paths, swimming pools, children's playgrounds and sandboxes, mini-markets, and cafés within the garden (Table 1, Figure 2) [30, 31]. The project received 63 points in the LEED BD+C New Construction (v2009) category and was certified at the gold level in April 2015 (Figure 3) [32].

To take advantage of natural light, which is one of the most important factors in ensuring energy efficiency in residential buildings, the openings in the double-skin façades of the building are high; however, the number of operable windows, which is an important factor in natural ventilation, was insufficient (Figure 4).

Figure 1. Location and appearance of multistorey dwelling building where the model was applied

Table 1. Building features and systems

Feature	Details
Building location and orientation	Located in Zincirlikuyu, Istanbul. It is situated north of the 1st Ring Road and west of the Istanbul Bosphorus, 400 m from Büyükdere Street and Gayrettepe Metro Station.
Building design	The building has 46 storeys (34 residential, three penthouses, three offices, two technical/social floors, and four parking levels), double-skin façade with specialized glazing for insulation and air circulation, and communal spaces through mass movement.
Construction materials	Reinforced concrete, high-performance glass, and thermal insulation layers.
Sustainability features	Vertical gardens for natural ventilation, rainwater harvesting for irrigation, and solar panels for energy production. Greywater systems for reuse in garden irrigation.
Energy and heating, ventilation, and air conditioning (HVAC) systems	LEED-certified design: heat recovery systems achieving 20 % energy savings, water-saving infrastructure reducing consumption by 30 %, 24/7 mechanical ventilation and local control systems for air conditioning.
Green spaces and landscaping	5,600-m^2 green area including terraces, courtyards, and private apartment gardens with low water-consumption trees.
Social and technical amenities	A control centre is in place to manage the building's air handling units, HVAC systems, exhaust fans, water tanks, rainwater and condensate systems, and energy systems. Social amenities include 24-hour security, fibre-optic internet, indoor and outdoor swimming pools, a fitness centre, and concierge services.

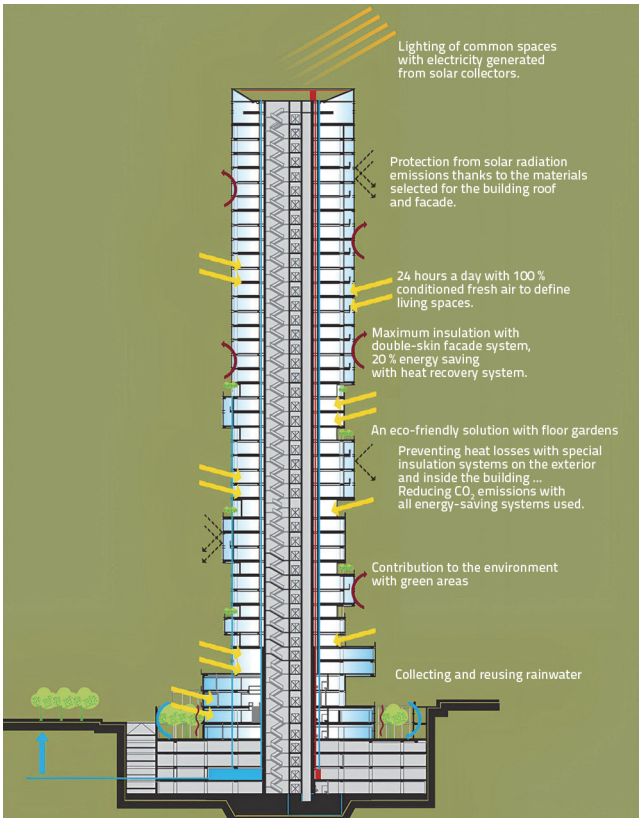

Figure 2. Energy-efficient features of building (modified image [31])

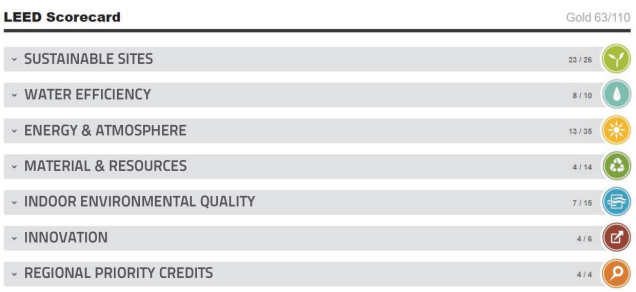

Figure 3. LEED project certification information [32]

Figure 4. Photographs demonstrating insufficient number of operable windows on the façade

In terms of artificial lighting, which is also an important factor in energy use, the most common lighting elements in the building are spotlights and LED lighting (Figure 5).

Figure 5. Artificial lighting elements used in building

To avoid the use of non-renewable fossil fuels, ceiling-type and floor-heating convector-type heating, ventilation, and air conditioning (HVAC) systems are used (Figure 6).

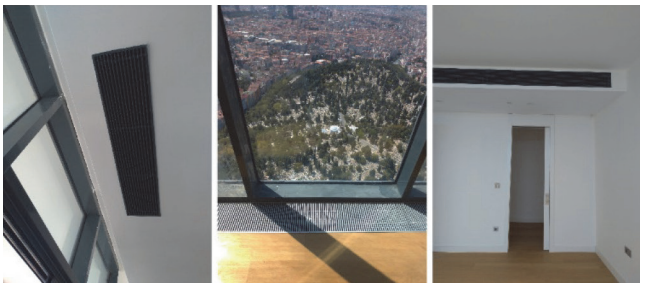

Figure 6. HVAC systems used in building (author's personal archive)

Electric cookers are one of the preferred options for avoiding the use of non-renewable fossil fuels in buildings, and water-saving taps are used to consume less water. Control-panel systems are used to control the systems in energy-efficient housing structures.

These panels are used to control HVAC, lighting, surveillance cameras, alarms, security devices, curtain/blind control, housing management announcement monitoring, and service request management. To encourage the use of electric vehicles, electric vehicle charging points are located within the building (Figure 7).

Figure 7. Building electric vehicle charging station

An in-building ultraviolet (UV) water treatment system is used to disinfect tap water (Figure 8).

Figure 8. Building rainwater UV treatment system

Figure 9. Building rainwater booster room and systems

Figure 10. Building control centre automation system

For rainwater harvesting, rainwater collected from the roof and other hard-ground areas of the building is filtered into a booster room. The collected water is directed to the areas required for irrigation through a garden irrigation line (Figure 9). Greywater treatment and reuse are provided within the building.

A control centre is located at the parking level of the building to control the building's air-handling units, HVAC systems, exhaust fans, water tanks, rainwater and condensate systems, and energy systems (Figure 10).

3.2. Methods

This study aimed to evaluate and implement the developed user satisfaction model in energy-efficient dwellings (for details, see [33]) to examine the satisfaction levels of residents in a multistorey housing project in Istanbul. The themes and sub-indicators of the model were identified during the data collection and preparation processes. The set of indicators was obtained from two sources:

- user satisfaction criteria for energy-efficient buildings and certification systems, and
- user satisfaction indicators from the literature and housing quality standards.

The indicators obtained were classified into main themes through elimination and integration cycles. During the model building process, fieldwork was carried out with the classified indicators, and scale analyses (factor analyses, validity, and reliability studies carried out to measure an abstract concept accurately) were carried out with the data obtained from fieldwork. The statistical results are expressed in tables. Graphical representations of the model were created in accordance with the statistical data and results of the analyses. The themes and indicators finalised as a result of the analyses are expressed in network graphics, which were considered the most appropriate for expressing the model.

3.2.1. User satisfaction model in energy-efficient dwellings

The model consists of the following four themes:

- **Comfort conditions:** includes indicators that vary depending on the active and passive systems preferred in energy-efficient dwellings, system control mechanisms, building and space design, and materials and fixtures used,
- **Dwelling–environment relationship:** includes the relationship of the dwellings with their environment and the community relations within the dwelling/site,
- **Health**: as one of the main themes of the model, health includes indicators related to health problems that residential users may face depending on the systems and preferences used in energy-efficient dwellings, and

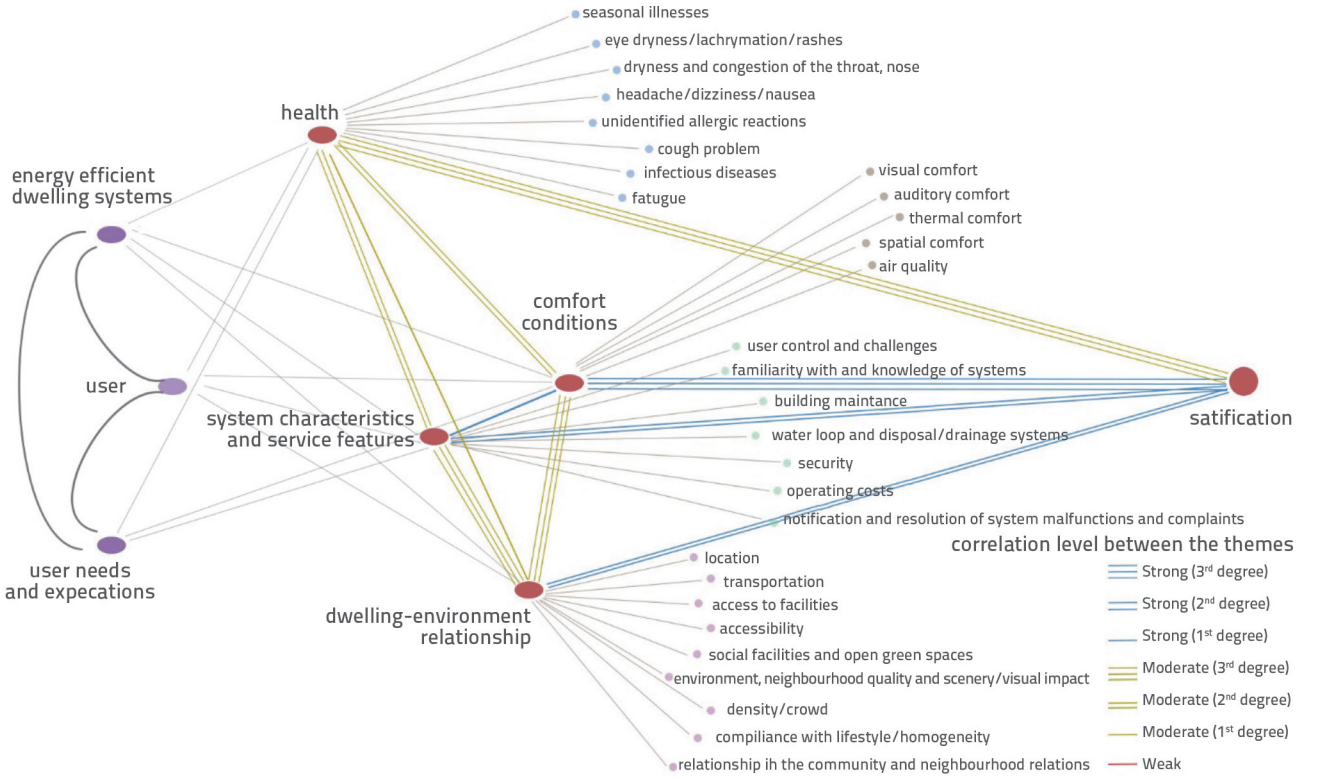

Figure 11. User-satisfaction model for energy-efficient dwellings [33]

- **System characteristics and service features:** encompasses various aspects related to user interactions with systems, operational efficiency, and maintenance.

Each theme in the model includes indicators for its realisation. The comfort conditions theme includes visual, auditory, thermal, and spatial comfort, and air quality indicators. The dwelling–environment relationship theme includes indicators such as location, transportation, access to facilities, accessibility, social facilities, open and green spaces, neighbourhood quality and scenery/visual impact, density/crowd, compliance with lifestyle/homogeneity, relationships in the community, and neighbourhood relations. The health theme includes seasonal illnesses, cough problems, eye dryness/lachrymation/rashes, dryness and congestion of the throat/nose, headache/dizziness/nausea, unidentified allergic reactions, infectious diseases, and fatigue. The system characteristics and service features theme includes indicators of user control and challenges, familiarity with and knowledge of systems, building maintenance, water loops, disposal/drainage systems, security, operating costs, notification, and resolution of system malfunctions and complaints (Figure 11) [33, 34]. In the model application phase, field studies were conducted in residential buildings, and the model was tested with data obtained through a questionnaire distributed to the residents. Radar charts were used to express the model results.

3.2.2. Statistical analysis

The field survey was conducted over a two-month period from July to August. The participants consisted of tenants and property owners from the residential section of the building, ensuring a representative sample of users directly affected by the living conditions and design features. The survey employed a structured questionnaire to assess various aspects of user satisfaction, which can be found in the Appendix. The study included 52 participants and an evaluation form was completed. All data were recorded and analysed using IBM SPSS Statistics for Windows version 22 [35]. The demographic information of the participants is presented in Table 2.

The distribution of residential users' general satisfaction levels with their dwellings (where 1 represents the lowest level and 5 the highest level) is presented in Table 3.

When analysing the data, the first step was to test the assumptions to decide which tests (parametric/nonparametric) to use. Kolmogorov–Smirnov, kurtosis, and skewness values and histograms were used to determine the normality of the distribution. If the kurtosis and skewness values were between ±2.0 [36], it was assumed that the values were normally distributed. An independent samples t-test was used to compare two independent groups, and a one-way Bonferroni test was used to compare two or more unrelated groups. The relationships between variables were analysed using Spearman's correlation coefficients.

Table 2. Participants demographic distribution

Demographic		N	Postotak
Gender	Male	28	53.8
	Female	24	46.2
Age	18–29	11	21.2
	30–39	14	26.9
	40–49	11	21.2
	≥50	16	30.8
Marital status	Married	23	44.2
	Single	29	55.8
Ownership status	Tenant	23	44.2
	Property owner	29	55.8
Education	High school or less	16	30.8
	Undergraduate	22	42.3
	Postgraduate	14	26.9
Household monthly income (TL) *The minimum wage at the time of the study was 3.000 TL. (Notes: 1 TL = 0.024 EUR)	3.001–7.500	14	26.9
	7.501–10.000	19	36.5
	≥10.000	19	36.5
Household size	1–2 people	23	44.2
	3–4 people	21	40.4
	≥ 50	8	15.4

Notes: N - number of respondents in each category; % - percentage of respondents in each category relative to total sample; TL -Turkish Lira

Table 3. General dwelling satisfaction levels

	Level	N	[%]
General satisfaction levels regarding dwellings	1	2	3.8
	2	7	13.5
	3	16	30.8
	4	20	38.5
	5	7	13.5

Notes: N - number of respondents in each category; % - percentage of respondents in each category relative to total sample

Table 4. Analysis method result comparisons

Theme	Kolmogorov–Smirnov			Shapiro–Wilk			Skewness	Kurtosis
	Statistics	df	p	Statistics	df	p		
Comfort conditions	0.11	52	0.10	0.97	52	0.29	-0.35	0.42
Dwelling–environment relationship	0.17	52	0.01	0.95	52	0.05	-0.25	-0.63
Health	0.12	52	0.07	0.95	52	0.02	0.15	-0.98
System characteristics and service features	0.07	52	0.20	0.98	52	0.58	-0.39	0.11
Overall satisfaction	0.06	52	0.20	0.98	52	0.56	0.04	0.33

Notes: df - degrees of freedom; p = p-value significance level; Statistics - test statistic value; Skewness - asymmetry of data distribution; Kurtosis - tailedness of data distribution

Table 5. Comparison of satisfaction levels and themes by sex

Theme	Gender	$\overline{X}$ ± Ss	t	df	p
Comfort conditions	male	3.24 ± 0.50	1.54	50	0.13
	female	2.97 ± 0.75			
Dwelling–environment relationship	male	3.47 ±0.53	1.90	50	0.06
	female	3.17 ± 0.62			
Health	male	2.98 ± 1.11	-0.30	50	0.76
	female	3.07 ± 1.14			
System characteristics and service features	male	3.10 ± 0.86	-1.81	50	0.08
	female	3.50 ± 0.73			
Overall satisfaction	male	3.26 ± 0.46	0.79	50	0.43
	female	3.14 ± 0.63			

Notes: Ss - mean ± standard deviation (average value and variability); t - test statistic value from independent samples t-test; df - degrees of freedom; p = p-value significance level

Table 6. Comparison of satisfaction levels and themes by marital status

Theme	Marital status	$\overline{X}$ ± Ss	t	df	p
Comfort conditions	married	3.16 ± 0.62	0.53	50	0.60
	single	3.07 ± 0.66			
Dwelling–environment relationship	married	3.41 ± 0.51	0.91	50	0.37
	single	3.27 ± 0.65			
Health	married	3.13 ± 1.03	0.59	50	0.56
	single	2.94 ± 1.19			
System characteristics and service features	married	3.53 ± 0.70	1.92	50	0.06
	single	3.09 ± 0.87			
Overall satisfaction	married	3.31 ± 0.51	1.26	50	0.21
	single	3.12 ± 0.56			

Notes: Ss - mean ± standard deviation (average value and variability); t - test statistic value from independent samples t-test; df - degrees of freedom; p = p-value significance level

Table 7. Comparison of satisfaction levels and themes according to ownership status

Theme	Ownership status	$\overline{X}$ ± Ss	t	df	p
Comfort conditions	tenant	2.88 ± 0.65	-2.39	50	0.02
	property owner	3.29 ± 0.58			
Dwelling–environment relationship	tenant	3.35 ± 0.65	0.21	50	0.84
	property owner	3.32 ± 0.54			
Health	tenant	2.58 ± 0.96	-2.68	50	0.01
	property owner	3.37 ± 1.12			
System characteristics and service features	tenant	3.24 ± 0.64	-0.32	50	0.75
	property owner	3.32 ± 0.95			
Overall satisfaction	tenant	3.08 ± 0.56	-1.54	50	0.13
	property owner	3.31 ± 0.51			

Notes: Ss - mean ± standard deviation (average value and variability); t - test statistic value from independent samples t-test; df - degrees of freedom; p = p-value significance level

Table 8. Comparison of satisfaction levels and themes according to educational level

Theme	Education level	$\overline{X}$ ± Ss	Source of variance	T.S.S.	df	M.S.	F	p	Difference
Comfort conditions	High school and less (1)	3.20 ± 0.71	B.G.V.	2.01	2	1.00	2.62	0.08	
	Undergraduate (2)	2.89 ± 0.63	W.G.V.	18.80	49	0.38			
	Postgraduate (3)	3.36 ± 0.48	Total	20.81	51				
Dwelling–environment relationship	High school and less (1)	3.61 ± 0.63	B.G.V.	3.28	2	1.64	5.58	0.01	1 > 2
	Undergraduate (2)	3.05 ± 0.54	W.G.V.	14.39	49	0.29			
	Postgraduate (3)	3.45 ± 0.43	Total	17.66	51				
Health	High school and less (1)	2.98 ± 1.39	B.G.V.	0.07	2	0.03	0.03	0.97	
	Undergraduate (2)	3.02 ± 0.98	W.G.V.	63.49	49	1.30			
	Postgraduate (3)	3.07 ± 1.05	Total	63.55	51				
System characteristics and service features	High school and less (1)	3.68 ± 0.70	B.G.V.	8.73	2	4.37	8.32	0.00	1 & 3 > 2
	Undergraduate (2)	2.81 ± 0.79	W.G.V.	25.71	49	0.52			
	Postgraduate (3)	3.58 ± 0.64	Total	34.44	51				
Sveukupno zadovoljstvo	High school and less (1)	3.41 ± 0.54	B.G.V.	2.76	2	1.38	5.51	0.01	1 & 3 > 2
	Undergraduate (2)	2.94 ± 0.50	W.G.V.	12.27	49	0.25			
	Postgraduate (3)	3.40 ± 0.46	Total	15.02	51				

Notes: Ss - mean ± standard deviation (average value and variability); T.S.S. - total sum of squares; df: degrees of freedom; MS - mean square; F = F-statistic value; p = p-value significance level; Difference - significant group difference; B.G.V. - between-group variance; W.G.V. - within-group variance.

A significance level of 0.05 was used as the criterion for interpreting whether the values obtained were significant (Table 4). Based on the comparison of analysis results, the Kolmogorov–Smirnov analysis was selected as the analysis method.

A comparison of satisfaction levels and themes by sex is presented in Table 5. None of the themes showed statistically significant differences according to gender ($p > 0.05$).

A comparison of the satisfaction levels and themes by marital status is presented in Table 6. None of the themes showed statistically significant differences according to marital status ($p > 0.05$).

A comparison of satisfaction levels and themes according to education level is presented in Table 8. The dwelling–environment relationship sub-dimension scores showed a statistically significant difference according to the educational level of individuals [$F(2.49) = 5.58$ $p < 0.05$]. According to the Bonferroni multiple comparison test, the sub-dimension scores of the dwelling–environment relationship for people with a high school education or less were significantly higher than those with an undergraduate education.

A statistically significant difference existed in the scores of the system characteristics and service features theme according to the educational level of the participants [$F(2.49) = 8.32$, $p < 0.05$]. The scores of those with a high school education or lower and those with a postgraduate education were significantly higher than those with an undergraduate education.

The overall satisfaction scores showed a statistically significant difference according to the educational level of the participants [$F(2.49) = 5.51$ $p < 0.05$]. The total satisfaction scores of those with a high school education or lower and those with a postgraduate education were significantly higher than those with an undergraduate education.

Comfort conditions and health theme levels did not show a statistically significant difference according to the educational level of the respondents ($p > 0.05$). A comparison of satisfaction levels and themes according to monthly household income is presented in Table 9. The system characteristics and service feature theme scores showed a statistically significant difference according to the income level of the participants [$F(2.49) = 6.27$ $p < 0.05$]. According to the Bonferroni multiple comparison test, the system characteristics and service features sub-dimension scores of those with an income of 10,000 TL and above were significantly higher than those with an income of 3.001–7.500 TL (1 TL = 0.024 EUR).

Comfort conditions, dwelling–environment relationships, health, and overall satisfaction levels did not show a statistically significant difference according to the participants' income levels ($p > 0.05$).

A comparison of satisfaction levels and themes according to household size is presented in Table 10. None of the themes showed statistically significant differences according to household size ($p > 0.05$).

Table 9. Comparison of satisfaction levels and themes according to monthly household income

Theme	Household monthly income (TL)	$\overline{X}$± Ss	Source of variance	T.S.S.	df	M.S.	F	p	Difference
Comfort conditions	3.001–7.500	3.13 ± 0.47	B. G. V.	1.00	2.00	0.50	1.24	0.30	
	7.501–10.000	2.94 ± 0.63	W. G. V.	19.81	49.00	0.40			
	>10.000	3.26 ± 0.74	Total	20.81	51.00				
Dwelling–environment relationship	3.001–7.500	3.06 ± 0.63	B. G. V.	1.49	2.00	0.74	2.25	0.12	
	7.501–10.000	3.47 ± 0.63	W. G. V.	16.18	49.00	0.33			
	>10.000	3.40 ± 0.47	Total	17.66	51.00				
Health	3.001–7.500	2.70 ± 1.12	B. G. V.	3.56	2.00	1.78	1.45	0.24	
	7.501–10.000	2.94 ± 0.90	W. G. V.	60.00	49.00	1.22			
	>10.000	3.34 ± 1.28	Total	63.55	51.00				
System characteristics and service features	3.001–7.500	2.71 ± 0.82	B. G. V.	7.01	2.00	3.51	6.27	0.01	3 > 1
	7.501–10.000	3.36 ± 0.69	W. G. V.	27.43	49.00	0.56			
	>10000	3.63 ± 0.75	Total	34.44	51.00				
Overall satisfaction	3.001–7.500	2.99 ± 0.39	B. G. V.	1.26	2.00	0.63	2.25	0.12	
	7.501–10.000	3.20 ± 0.53	W. G. V.	13.76	49.00	0.28			
	>10.000	3.38 ± 0.61	Total	15.02	51.00				

Notes: Ss - mean ± standard deviation (average value and variability); T.S.S. - total sum of squares; df: degrees of freedom; MS - mean square; F = F-statistic value; p = p-value significance level; Difference - significant group difference; B.G.V. - between-group variance; W.G.V. - within-group variance.

Table 10. Comparison of satisfaction levels and themes according to household size

Theme	Household size	$\overline{X}$± Ss	Source of variance	T.S.S.	df	M.S.	F	p	Difference
Comfort conditions	1–2 people	3.01 ± 0.64	B. G. V.	0.47	2	0.24	0.57	0.57	
	3–4 people	3.21 ± 0.66	W. G. V.	20.34	49	0.42			
	≥5 people	3.13 ± 0.61	Total	20.81	51				
Dwelling–environment relationship	1–2 people	3.26 ± 0.57	B. G. V.	1.00	2	0.50	1.46	0.24	
	3–4 people	3.49 ± 0.51	W. G. V.	16.67	49	0.34			
	≥5 people	3.13 ± 0.79	Total	17.66	51				
Health	1–2 people	2.86 ± 1.08	B. G. V.	2.26	2	1.13	0.90	0.41	
	3–4 people	3.27 ± 1.13	W. G. V.	61.30	49	1.25			
	≥5 people	2.81 ± 1.20	Total	63.55	51				
System characteristics and service features	1–2 people	3.32 ± 0.68	B. G. V.	0.06	2	0.03	0.04	0.96	
	3–4 people	3.25 ± 0.80	W. G. V.	34.38	49	0.70			
	≥5 people	3.26 ± 1.28	Total	34.44	51				
Overall satisfaction	1–2 people	3.14 ± 0.54	B. G. V.	0.43	2	0.21	0.72	0.49	
	3–4 people	3.32 ± 0.55	W. G. V.	14.60	49	0.30			
	≥5 people	3.13 ± 0.54	Total	15.02	51				

Notes: Ss - mean ± standard deviation (average value and variability); T.S.S. - total sum of squares; df: degrees of freedom; MS - mean square; F = F-statistic value; p = p-value significance level; Difference - significant group difference; B.G.V. - between-group variance; W.G.V. - within-group variance.

Table 11. Comparison of satisfaction levels and themes according to age

Theme	Age	$\bar{X}$±Ss	Source of variance	T.S.S.	df	M.S.	F	p	Difference
Comfort conditions	18–29	2.87 ± 0.41	B. G. V.	1.08	3	0.36	0.88	0.46	
	30–39	3.29 ± 0.59	W. G. V.	19.73	48	0.41			
	40–49	3.14 ± 0.79	Total	20.81	51				
	≥50	3.10 ± 0.70							
Dwelling–environment relationship	18–29	3.18 ± 0.71	B. G. V.	0.78	3	0.26	0.74	0.54	
	30–39	3.51 ± 0.49	W. G. V.	16.89	48	0.35			
	40–49	3.37 ± 0.61	Total	17.66	51				
	≥50	3.25 ± 0.58							
Health	18–29	2.92 ± 1.09	B. G. V.	3.62	3	1.21	0.97	0.42	
	30–39	3.01 ± 1.14	W. G. V.	59.94	48	1.25			
	40–49	3.50 ± 1.24	Total	63.55	51				
	≥50	2.77 ± 1.02							
System characteristics and service features	18–29	2.52 ± 0.78	B. G. V.	10.90	3	3.63	7.41	0.00	2.3>1
	30–39	3.42 ± 0.83	W. G. V.	23.54	48	0.49			
	40–49	3.91 ± 0.42	Total	34.44	51				
	≥50	3.26 ± 0.67							
Overall satisfaction	18–29	2.92 ± 0.26	B. G. V.	1.68	3	0.56	2.01	0.13	
	30–39	3.36 ± 0.56	W. G. V.	13.35	48	0.28			
	40–49	3.39 ± 0.55	Total	15.02	51				
	≥ 50	3.15 ± 0.61							

Notes: Ss - mean ± standard deviation (average value and variability); T.S.S. - total sum of squares; df: degrees of freedom; MS - mean square; F = F-statistic value; p = p-value significance level; Difference - significant group difference; B.G.V. - between-group variance; W.G.V. - within-group variance.

A comparison of the satisfaction levels and themes by age is presented in Table 11. The scores for the themes of system characteristics and service features showed a statistically significant difference according to the age [$F(2.49) = 6.27$, $p < 0.05$]. According to the Bonferroni multiple comparison test, the system characteristics and service feature theme scores of people in the 30–39 and 40–49 age groups were significantly higher than those in the 18–29 age group.

Comfort conditions, dwelling–environment relationships, health, and overall satisfaction levels did not show statistically significant differences according to respondents' age ($p > 0.05$).

The relationships between general satisfaction and themes are presented in Table 12. The general satisfaction level with the dwelling reflects the participants' self-reported rating of their satisfaction with their specific dwelling on a scale of 1 to 5. In contrast, overall satisfaction was calculated as the mean satisfaction score based on responses to all survey items across different themes. A statistically significant, positive, and moderate correlation

Table 12. Relationship between overall dwelling satisfaction level and theme satisfaction scores

Theme		General dwelling satisfaction level
Comfort conditions	r	0.47
	p	0.01
Dwelling–environment relationship	r	0.44
	p	0.01
Health	r	0.39
	p	0.01
System characteristics and service features	r	0.67
	p	0.01
Overall satisfaction	r	0.64
	p	0.01

Notes: r - correlation coefficient; p = p-value indicating statistical significance

existed between the theme scores (r: 0.47, r: 0.44, r: 0.39, r: 0.67, r: 0.64, $p < 0.05$, respectively) and general dwelling satisfaction level ($r < 0.30$ = low, $0.31 < r < 0.70$ = medium, and $r > 0.70$ = high).

4. Results

In the study's multistorey residential building, the satisfaction levels obtained from the four main themes according to demographic information and the relationships between them are shown in Figure 12. Considering the significant gender differences, men had lower satisfaction levels than women in the system characteristics and service featured theme, possibly because of men's different expectations or experiences regarding system features and service provision, which may be influenced by factors such as accessibility and personal preferences. With regard to the dwelling–environment relationship, the satisfaction level of women was lower. This could reflect the differences in how women and men perceive the interaction between their living spaces and the environment, which is potentially linked to the influence of environmental factors on women's daily routines.

In terms of ownership status, the tenants had lower satisfaction levels than that of property owners in terms of comfort and health. This may be related to tenants having less control over their living environment than property owners.

A significant difference in marital status was observed in the system characteristics and service features theme, where single people had lower satisfaction levels than those of married people. This could indicate that married individuals, possibly living in larger or better-equipped homes, have a more positive perception of system features and services than that of single people.

Residents in the 40–49 age group were more satisfied with health than those in other age groups, possibly because they are more aware of and prioritize health-related factors. Regarding system characteristics and service features, the 18–29 age group had the lowest level of satisfaction, while the 40–49 age group had the highest level of satisfaction. The younger group might expect more modern or innovative system features, whereas older individuals may find available features more aligned with their needs.

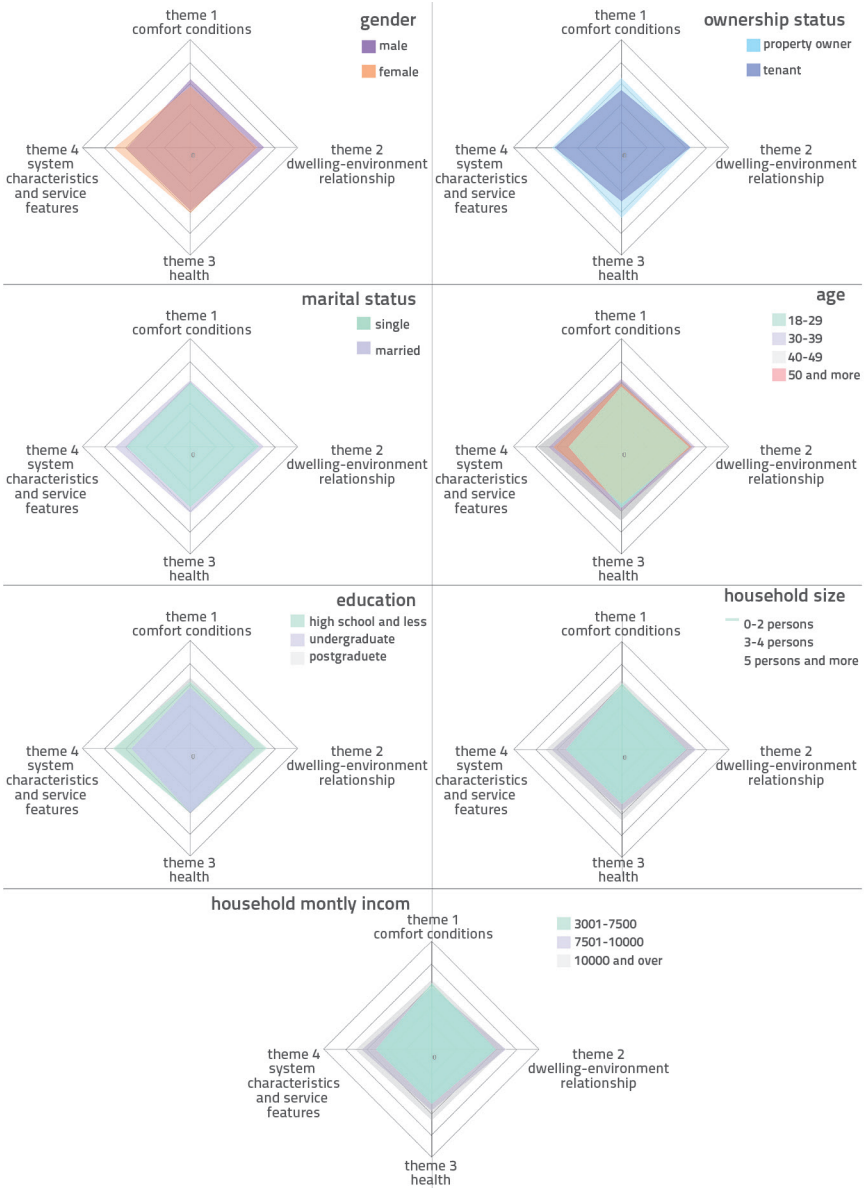

Figure 12. Satisfaction level relationships in themes according to demographics

Considering the level of education, undergraduates had a lower level of satisfaction than those with a high school degree or less and postgraduates in the comfort conditions, system characteristics and service features, and dwelling–environment relationship themes. This could reflect that undergraduates may have more critical expectations or standards for these features than those of other groups.

When a general assessment was made according to monthly household income, satisfaction increased with an increase in income level. In the areas of health and system characteristics and service features, participants with an income of 3.001–7.500 TL had the lowest level of satisfaction, while those with an income of over 10,000 TL had the highest level of satisfaction. In terms of the dwelling–environment

Figure 13. Relationships between satisfaction levels within and between themes

relationship, the group with an income of 3.001–7.500 TL had the lowest level of satisfaction. Income directly influences the ability to afford better services and living conditions, which explains the disparity in satisfaction across the income groups.

Considering the significant differences in household size, it can be seen that the satisfaction level of the 3–4-person group was higher than that of the other groups in the dwelling–environment relationship and health themes. One possible explanation is that a household size of 3–4 people provides an optimal balance, where the living space is neither overcrowded nor underutilised, fostering a more comfortable and harmonious living environment.

The dwelling satisfaction levels obtained in relation to the four main themes and sub-indicators are shown in Figure 13.

The first radar chart illustrates user satisfaction levels across five comfort parameters: visual, auditory, thermal, spatial, and air quality. The results show that the thermal and spatial comfort scores were relatively high compared with the others, indicating that these aspects are well addressed in the building. However, the auditory and air quality comfort showed lower satisfaction levels, suggesting areas for improvement. The visual comfort fell within the middle range. The factors contributing to the low level of satisfaction with the auditory comfort indicator were thought to be the noise generated by the indoor and outdoor HVAC units and the inadequate level of soundproofing between rooms in the dwelling. Regarding air quality, the lack of natural ventilation, dryness of the air circulating indoors, and creation of indoor air currents by HVAC systems are cited as other reasons for lower satisfaction levels.

The Theme 2 chart evaluates satisfaction with four parameters: location, accessibility, transportation, and lifestyle compliance. Satisfaction scores for access to facilities, location, and transportation were the highest, indicating that users were generally satisfied with the building's connectivity and transportation options. Satisfaction with accessibility, social facilities, open and green spaces, density/crowd, and community and neighbourhood relations was lower than that of other indicators. The factors influencing the lower level of satisfaction were the insufficient accessibility of the building and its surroundings for disabled and elderly people, the insufficient amount of open and green spaces in relation to the density of users, and the limited opportunities to contribute to the development of neighbourhood relations.

The radar chart for health-related issues indicates that dryness and congestion of the throat and nose were the most significant complaints contributing to the lowest satisfaction scores. This highlights the potential problems of air humidity levels, inadequate ventilation systems, and lack of natural ventilation. Additionally, fatigue emerged as the second most frequent complaint, indicating that factors such as poor indoor air quality and insufficient

lighting may cause users to feel drained or unwell. Eye dryness/lachrymation/rashes and seasonal illnesses also contributed to relatively low health satisfaction scores, suggesting that environmental factors such as allergens or inadequate air circulation might play a role. Unidentified allergic reactions and infectious diseases scored higher, indicating that general hygiene and building maintenance may mitigate these concerns. These findings underscore the importance of improving indoor air quality, optimising humidity control systems, and addressing fatigue-inducing factors to enhance residents' overall health satisfaction.

The radar chart for the system characteristics and service features highlights user control and challenges as moderate aspects of satisfaction. This indicates that residents may find it difficult to operate or adapt to a building's systems such as heating, cooling, or smart home technologies. This could stem from a lack of an intuitive design, inadequate user training, or overly complex system interfaces. Improving system usability and providing better user guidance can significantly enhance user satisfaction in this area. Operating costs also showed relatively low satisfaction levels. This suggests that residents may perceive the utility and maintenance expenses as excessive or inconsistent with their expectations. Unexpected maintenance fees may have contributed to this issue. However, security and building maintenance are among the better-performing aspects, reflecting positive resident experiences in these areas. This suggests that the building effectively addresses safety concerns and provides reliable updates of common spaces and facilities. Finally, familiarity with and knowledge of the systems scores were lower, suggesting that some users might still require additional support. Strengthening communication and education regarding system functionality can further enhance satisfaction.

In the last chart comparing all themes, the overall level of dwelling satisfaction was 64 %. The themes comfort conditions, dwelling–environment relationship, and system characteristics and service features obtained a satisfaction level above 60 %, while the health theme had a satisfaction level below 60 %. When evaluating the main themes in the analysed building, the satisfaction level for the health theme was lower than that of the other themes. One reason for this is that the number of windows that could be opened and the possibility of natural ventilation were insufficient. Additionally, the inability to regulate humidity and temperature could be cited as a reason for lower health satisfaction. Considering that the dryness of the air caused by the air conditioning system is a determinant of upper respiratory tract complaints, it is to be expected that the level of satisfaction in the health theme will be lower. The regular and correct performance of filter cleaning, maintenance, and replacement of HVAC systems is important.

5. Discussion

This study highlights the critical aspects of user satisfaction in an energy-efficient high-rise housing building. While the overall satisfaction rate was moderate (64 %), disparities across different themes warrant attention. Themes like comfort conditions, dwelling–environment relationship, and system characteristics and service features achieved satisfaction levels above 60 %, while health fell below this threshold. These results align with and expand upon those of previous studies in several key areas.

The lower satisfaction level in the health theme can be attributed to insufficient natural ventilation and the dryness caused by HVAC systems, which exacerbate upper respiratory complaints, and is consistent with findings by Omrani et al. [37] who showed that inadequate natural ventilation and reliance on mechanical HVAC systems often compromise air quality and thermal comfort in high-rise buildings. Their study found that cross ventilation is significantly more effective than single-sided ventilation in maintaining thermal comfort and reducing air dryness. Similarly, Frontczak and Wargocki [38] emphasised that occupant control over air quality and temperature is a pivotal determinant of health-related satisfaction, which was also lacking in the studied dwellings. Similarly, Roetzel et al. [39] demonstrated that user behaviour related to window opening directly affects both thermal comfort and air quality. The introduction of more operable window designs into green buildings is recommended. Lee and Guerin [40] highlighted the critical role of user satisfaction with indoor air quality in LEED-certified buildings, emphasising its impact on occupant comfort and overall building performance.

The comfort conditions theme demonstrated moderate satisfaction levels, with noise and air quality emerging as common issues. Frontczak et al. [41] identified noise as a major factor contributing to quality (IEQ) dissatisfaction. This finding aligns with auditory comfort concerns, particularly in mechanically ventilated buildings where HVAC systems contribute to the acoustic disruptions observed in this study. Additionally, the lack of natural ventilation and the resulting indoor air stagnation mirror issues described by Omrani et al. [37] who advocate for the incorporation of more operable windows and mixed-mode ventilation systems to enhance comfort. Lee and Guerin [40] noted in their study that acoustic comfort significantly influences user performance and satisfaction. Therefore, improving the soundproofing and employing quieter mechanical systems are recommended.

Satisfaction with accessibility, green spaces, neighbourhood density, and community interactions in the dwelling–environment relationship theme was lower than other aspects. This result parallels the findings of Omrani et al. [37]

who underlined the importance of external factors such as neighbourhood density, accessible green spaces, and public amenities in influencing occupant satisfaction. Incorporating more open and green areas and fostering community engagement can significantly enhance satisfaction in this domain. Similar to our findings, Jiang et al. [42] identified lack of neighbourhood connections and involvement in community management as factors that negatively affect user satisfaction. Our study also highlighted accessibility issues as a prominent concern, particularly for individuals with disabilities and the elderly.

The system characteristics and service features theme exhibited significant dissatisfaction regarding users' familiarity and control of systems and operational costs. Aligned with these study results, some researchers have noted that user familiarity, particularly with HVAC systems, is critical to overall satisfaction, suggesting that inadequate training or poorly designed user manuals may be key issues [38, 41, 43]. Roetzel et al. [39] underscored the importance of improving users' ability to control energy consumption systems to enhance energy efficiency and user satisfaction. Occupant control over operable windows significantly influenced perceived thermal comfort. Brager et al. [44] found that individuals with more control over window opening experienced higher neutral temperatures aligned with their immediate environment, despite having similar thermal conditions to those with less control. Haldi and Robinson [45] further supported this finding, showing that increased occupant control, whether through windows, blinds, or fans, enhanced comfort temperatures. Greater access to multiple controls is associated with higher comfort levels. Furthermore, the high operating costs align with concerns regarding the financial sustainability of mechanical systems as proposed by Omrani et al. [37].

Approximately 20 % of the participants in the study were tenants and property owners from the residential section of the building. This focus ensured that the results reflected the perspectives of individuals directly impacted by the living conditions and design features of the residential units. Including a larger or more diverse sample group in future research could provide a broader understanding of user satisfaction across an entire building.

6. Conclusions

This study highlights the importance of adopting a comprehensive and user-focused approach to improve user satisfaction in high-rise energy-efficient buildings. Although the overall satisfaction level was moderate, significant disparities across different themes indicated areas that require attention and improvement.

One critical step is to enhance natural ventilation in building designs. Insufficiently operable windows and heavy reliance on mechanical HVAC systems have a negative impact on indoor air quality, humidity levels, and user health. Future designs should incorporate hybrid ventilation systems that balance natural airflow with mechanical support to effectively address these concerns.

Minimising indoor and outdoor noise is another key area. The integration of quieter HVAC systems and improved acoustic insulation, particularly between rooms, is essential for meeting user expectations regarding auditory comfort. This has become increasingly important in high-density urban areas, where external noise sources are unavoidable.

The provision of accessible green spaces and community-oriented infrastructure is vital for enhancing the dwelling–environment relationship. Inadequate access to open and green spaces not only affects user satisfaction but also mental and physical well-being. Future designs should prioritise integrating sufficient greenery and fostering environments that promote social interactions.

Improving user control over building systems and addressing high operating costs are additional challenges. Simplifying the system interfaces and providing clear user manuals can empower residents to interact effectively with HVAC and energy systems. In addition, energy-efficient technologies combined with well-maintained systems can help reduce operating costs and align them with sustainability goals.

This study also underscores the potential of biophilic design and adaptive HVAC technologies to address these challenges. Biophilic design principles, such as incorporating natural elements into architectural layouts, can improve the indoor environmental quality while promoting psychological well-being. Adaptive HVAC technologies that dynamically adjust user requirements and external conditions can further enhance comfort and energy efficiency.

Thus, the design of energy-efficient buildings requires a balanced approach that prioritises user satisfaction and sustainability. By addressing the specific factors highlighted in this study, future buildings can better satisfy residents' expectations while contributing to a more sustainable urban environment. Future research should focus on long-term evaluations of user satisfaction to refine these strategies and identify the best practices for residential building design.

Acknowledgements

I extend my sincere gratitude to my esteemed mentor, Prof. Dr. N. Ferah Akıncı, for her invaluable support. My thanks also go to the building management team and residents for their assistance throughout the study.

Appendix- assessment form of user satisfaction scale in multi-story energy-efficient housing

Demographic Information							
Gender	Male	Female					
Age	18-29	30-39	40-49	50-59	over 59		
Marital status	Single	Married					
Ownership status	Property owner	Renter					
Education status	Literate	Primary school	Secondary school	High school	Associate degree	Undergraduate	Graduate
Monthly household income (TL)	0-3000	3001-7500	7501-10000	over 10000			

Please rate your general satisfaction level with your housing from 1 to 5			**1**	**2**	**3**	**4**	**5**
Theme	**Indicator**	**Assessment proposals**	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
COMFORT CONDITIONS	Visual comfort	I think natural lighting is sufficient.					
		I am satisfied that I do not encounter any reflection/flashing/glare or excessive contrast caused by window/glass surfaces windows/glass surfaces (TV, computer screen, etc.)					
		I think sunlight control in the building (sunshades etc.) is sufficient.					
		I think artificial lighting is sufficient (you can consider the regional sufficiency/ insufficiency of lamps, led, or spotlights).					
		I am satisfied with the equipment chosen for artificial lighting (Spot / LED lighting etc.)					
		I am not disturbed by glare, heat, shadow, or vibration caused by artificial lighting, I am satisfied.					
		I am satisfied with the artificial lighting elements with sensors.					
		I am satisfied with the colours used in the spaces.					
		I think the lighting in the site/landscape area is sufficient (Open, green areas, social facilities, on-site facilities, etc.)					
COMFORT CONDITIONS	Auditory comfort	I do not think the sounds caused by the indoor and outdoor units of HVAC (heating, cooling, and ventilation) systems are disturbing.					
		I think auditory privacy is ensured.					
	Thermal comfort	I think the heating level and balance of the spaces are appropriate.					
		I think the cooling level and balance of the spaces are appropriate.					
		I think the heating/cooling level and balance of the common areas of the building are appropriate.					
		I am satisfied with the Radiation Temperature (heat coming/reflecting directly from the heat source).					
		I am satisfied with the control system of the heating/cooling equipment (central system, share meter, or whether each flat has its own system).					
Please rate your general satisfaction level with your housing from 1 to 5			**1**	**2**	**3**	**4**	**5**

Theme	Indicator	Assessment proposals	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
COMFORT CONDITIONS	Spatial comfort	I am satisfied with the space organization and/or interior design (apartment plan, transitions, and relationship between rooms, space sizes)					
		I am satisfied with the layout, dimensions, quality of the fixed fittings (fixed elements such as kitchen cabinets), and the armatures used in wet areas (taps, etc.).					
		I am satisfied with the floor height.					
		I think it is a suitable environment for working from home.					
		I am not disturbed by vibration from vehicles, users, or wind, I am satisfied.					
		I am satisfied with the circulation areas (width and usefulness of stairs, corridors, elevators, and other areas)					
		I am satisfied with the common areas inside the building (lobby, entrance area, common terraces, etc.)					
	Air quality	I think the amount of fresh air in the indoor environment is sufficient.					
		I am satisfied with the air quality of the ventilation system.					
		I think the natural ventilation means are sufficient (the number of openable windows, the mean of cross airflow, etc.)					
		I think the ventilation facilities in wet areas are sufficient (bathrooms and toilets).					
		I am satisfied with the airflow from HVAC systems (heating, cooling, and ventilation systems).					
		I am satisfied with the airflow of natural ventilation.					
		I am not disturbed by the dry air circulating inside, I am satisfied.					
		I am not disturbed by smells caused by air pollution, I am satisfied.					
		I am not disturbed by the smell of the ingredients, I am satisfied.					
		I am not disturbed by the smells of food, I am satisfied.					
		I am not disturbed by toilet smells, I am satisfied.					
		I am not disturbed by damp smells, I am satisfied.					
Please rate your general satisfaction level with your housing from 1 to 5			1	2	3	4	5

Theme	Indicator	Assessment proposals	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
DWELLING-ENVIRONMENT RELATIONSHIP	Location	I am satisfied with the location of the site/dwelling.					
		I am satisfied with the distance of the site/residence to the city centre.					
		I think the site/dwelling area is sufficient for social life.					
		I think the site/dwelling is easily accessible in case of fire, earthquake, and other natural disasters.					
	Transportation	I think the site/dwelling is generally easily accessible.					
		I think the public transportation facilities around the site/dwelling are sufficient.					
		I am satisfied with the access of the site/residence to public transportation points.					
	Access to Facilities	I can easily access basic education institutions.					
		I can easily access health institutions.					
		I think it is easy to access police units.					
		I can easily access shopping areas (shopping malls, markets, etc.).					
		I think the entertainment areas are easy to access.					
Please rate your general satisfaction level with your housing from 1 to 5			1	2	3	4	5

Theme	Indicator	Assessment proposals	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
DWELLING-ENVIRONMENT RELATIONSHIP	Accessibility	I think the building is suitable for the access of people with disabilities and elderly people.					
	Social Facilities and open green areas	I think the open spaces in the site / around the building are sufficient.					
		I think the green areas in the site / around the building are sufficient.					
		I think the pedestrian paths/promenades areas in the site/ around the building are sufficient.					
		I think the bicycle paths in the site/ around the building are sufficient.					
		I think the number of parking lots is sufficient.					
		I think the recreation areas in the site / around the building are sufficient.					
		I think the children's park and playgrounds are sufficient and useful.					
		I think sports fields are sufficient.					
	Environment/neighbourhood quality and scenery / visual impact	I am satisfied with the quality of the environment/neighbourhood where the site/building is located.					
		I am satisfied with the scenery offered by the dwelling unit (Environment/neighbourhood view, the proximity of buildings, seeing the sky only, etc.).					
		I think the appearance of the site/building is beautiful and in harmony with the environment.					
	Density/ crowd	I am satisfied with the dwelling density in the site / around the building (Distance between blocks)					
		I am satisfied with the occupancy rate and user density within the site/building.					
	Compliance with lifestyle / homogeneity	I think the site/dwelling area conforms to my own culture and lifestyle.					
		I think that the profile of people living in the site/dwelling area shows a homogeneous distribution.					
	Relationships in the communit	I think neighbour relations are sufficient.					
		I think the residents of the site/building have a positive approach to the solution to the problems.					
Please rate your general satisfaction level with your housing from 1 to 5			**1**	**2**	**3**	**4**	**5**

Theme	Indicator	Assessment proposals	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
HEALTH	Seasonal illnesses	I often do not suffer from seasonal illnesses; I am satisfied with my dwelling in this regard.					
	Dry eyes/ lachrymation / rashes	I do not complain about dry eyes, lachrymation, and rashes, I am satisfied with my dwelling in this regard.					
	Dryness and congestion of the throat and	I do not complain about the dryness of the throat, dryness of the nose, and congestion, I am satisfied with my dwelling in this regard.					
	Headache / dizziness	I do not complain about headaches, dizziness, and nausea, I am satisfied with my dwelling in this regard.					
	Unidentified allergic reactions	I do not complain about having allergic reactions from time to time, I am satisfied with my dwelling in this regard.					
	Cough problem	I do not complain about having a cough problem from time to time, I am satisfied with my dwelling in this regard.					
	Fatigue	I do not complain about the feeling of fatigue, I am satisfied with my residence in this regard.					
	Infectious diseases	I do not complain about the occasional infectious diseases, I am satisfied with my dwelling in this regard (Consider especially the periods when you are at home for a long time).					
Please rate your general satisfaction level with your housing from 1 to 5			**1**	**2**	**3**	**4**	**5**

Theme	Indicator	Assessment proposals	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
SYSTEMIC CHARACTERISTICS AND SERVICE FEATURES	User control and challenges	I think the individual controllability of the heating and cooling systems is sufficient (central or room-based user control).					
		I think the individual controllability of the ventilation systems is sufficient (central or room-based user control).					
		I think the individual controllability of the lighting/shading elements is sufficient (light)					
		I think the number of openable windows is sufficient (Natural ventilation control)					
		I do not have problems in using control devices, I am satisfied (heating, cooling, ventilation, security, etc.)					
		I am satisfied that the devices can be adjusted precisely as I want (please take into account the conditions such as heating, cooling, ventilation devices, electric stove heating level adequacy)					
	Familiarity with and knowledge	I think the user manuals are sufficient.					
		I think the user guides are comprehensible.					
	Building maintenance	I am satisfied with the frequency and quality of building maintenance and waste management.					
		I am satisfied with the applications regarding the periodic control and renewal of amateurs and equipment.					
	Water loop and disposal/drainage systems	I do not have problems with the water cycle, disposal and drainage systems, I am satisfied (you can take into account water expenses, plumbing leaks and leaks, etc.)					
		I am satisfied that there are rainwater storage and network water treatment systems and the amount of water I use in my flat is clearly included in the invoices. I think I save money.					
	Security	I think the dwelling areas are safe from burglary.					
		I think the dwelling areas are safe from fire and natural disasters.					
		I think the in-site / indoor security is sufficient.					
	Operating costs	I think the building operating costs are appropriate (subscription expenses etc.).					
	Notification and resolution of system malfunctions and complaints	I do not have problems reporting system malfunctions and other problems and their solutions, I am satisfied.					
Please rate your general satisfaction level with your housing from 1 to 5			**1**	**2**	**3**	**4**	**5**

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