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The Impact Of Rapid Growth On The Architectural Aspects Of Housing Complexes In Sulaymaniyah City

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Abstract: This study addresses the problem of how rapid and often unregulated urban expansion in Sulaymaniyah City has significantly influenced the architectural quality, functionality, and livability of housing complexes. As the city experiences accelerated growth driven by population increases, economic activity, and investment flows, the built environment—particularly residential architecture—faces critical challenges. The aim of this research is to evaluate the architectural impacts of this rapid urban growth, focusing on how design standards, façade aesthetics, spatial planning, and livability are affected by mass housing development trends. Drawing on field data and insights from local architects, the study explores the deeper implications of urbanization on the lived experience and environmental sustainability of residential areas. Case studies and survey findings illustrate how urban planning decisions intersect with cultural and functional demands, highlighting the need for context-sensitive and adaptive design strategies. The study hypothesizes that rapid urban growth negatively affects architectural quality and livability, with housing design acting as a mediating factor—this relationship is tested through regression analysis. The results emphasize that urban quality of life depends not only on structural development but also on thoughtful architectural planning that integrates social and cultural dimensions. These findings provide actionable insights for architects, urban planners, and policymakers aiming to guide inclusive and sustainable housing development in rapidly changing urban settings.

Keywords: *Rapid Growth; Urbanization; Architectural Aspects; Housing Complexes*

1. Introduction

Developing countries face significant challenges due to the accelerating expansion of urban areas which shows no precedent in speed. Multiple elements contribute to this rapid growth such as economic development initiatives, increases in population numbers, and changing patterns of migration. Developing efficient urban policies and tackling fast-growing urbanization challenges requires understanding the forces behind city growth and their impacts on communities [1].

Several key factors contribute to city expansion in developing nations, including people moving from rural areas to cities, natural population growth, and converting rural regions into urban zones. These elements play a crucial role in shaping urban development and increasing the size of cities over time. These components interact in complex ways, often overlooked in traditional analyses focusing primarily on migration [2]. Historically, city growth followed a sequential pattern in which a country's largest cities developed at a high rate initially, followed by smaller cities once growth in its largest cities began to taper. The pattern repeated itself in multiple countries, and over multiple decades, a pattern has been seen in city growth across the globe [3]. However, high-rate urban expansion exerts tremendous pressure on available infrastructure, leading to water supply, sewage, transportation, and housing issues. Urban expansion also brings about environmental degradation in terms of increased pollution, a lack of parks, and more energy demands, which contribute to urban heat islands [4]. These

environmental impacts justify implementing sustainable urban development strategies to counteract negative impacts on urban ecosystems and enhance residents' quality of life [5]. While offering wonderful social and economic opportunities, rapid urban expansion also brings challenges that can deteriorate urban quality of life if not managed effectively. On the positive side, rapid urbanization typically drives economic

One of the main factors of imbalance in the urban development of cities is undoubtedly their growth rate. For this reason, among the significant characteristics of phenomena of rural-to-urban migration, which have guided megacities' growth in developing countries, is the need for a large mass to assimilate through rapid urban plot growth mechanisms. The urban plot and its growth in so-called developing countries have been among the most usual phenomena of change in different aspects of the landscape of the second part of the twentieth century [1].

Urbanization has rapidly transformed regions worldwide, driven by migration, economic shifts, and policy changes. In Latin America, cities have expanded due to rural-to-urban migration and high natural growth. However, this urbanization remains slower than in Asia and Africa, often leading to social and environmental challenges [6; García-Ayllón, 2016). Europe’s urbanization, rooted in the Industrial Revolution, accelerated post-WWII with economic integration, now shifting towards sustainability models like “15-minute cities” [7; 8] Asia’s rapid urban growth, particularly in China and Japan, has been fueled by industrialization and foreign investment, though housing and environmental concerns persist (UN-Habitat, 2016). South Africa’s cities, shaped by colonial legacies, continue to expand despite structural inequalities [9]. Turkey’s urbanization, centered around cities like Istanbul, has been driven by economic liberalization and infrastructure development [10]. The Gulf countries, particularly Dubai and Abu Dhabi, have leveraged oil wealth for rapid urban expansion, but challenges like labor imbalances and sustainability remain (Beblawi & Luciani, 1987; 11]. While tied to resource wealth, Iraq's urban growth faces a severe housing crisis, with Baghdad requiring over a million new units by 2040.

Within Iraq, the Kurdistan region has experienced accelerated urban growth, driven by economic development, political stability, and migration from conflict-affected areas in the south and center of the country. Cities like Erbil, Sulaymaniyah, Duhok, and Soran have undergone rapid expansion, often lacking comprehensive urban planning, which has led to land-use transformations, rising property values, environmental pressures, and socio-economic shifts [13]. The administrative autonomy granted to Kurdistan in 2004 played a pivotal role in the economic boom of Sulaymaniyah, driving real estate development, industrial expansion, and increased farmland demand. This prosperity, however, also contributed to urban sprawl, particularly along key corridors and city entrances, altering the city's structure and reinforcing broader patterns of urban expansion observed across rapidly growing regions worldwide. The Kurdistan experience underscores the complex interplay of governance, economic opportunity, and migration in shaping urban growth, much like other emerging urban centers striving to balance development with sustainable planning.

The growth of Sulaymaniyah City is a consequence of the widespread uncontrolled building development in the city, especially in the foothills of the surrounding mountains. New buildings on a large scale are being erected in all directions along the sides of the ring roads. This is happening due to a growth in population, demand for apartments, growth in residents' income, and the entry of new foreign firms' investment funds. With this big influx, a significant change in living style in the complex has been observed. Besides this, the size of the city has been stretched extensively. The assessment of fast city expansion relies on several key factors, including urban sprawl, population growth, and housing development, all closely connected. The capacity of a city to support population growth and enhance economic activities through total urban area [14], economic development, and infrastructure

advancements makes these measures essential for urban sustainability assessments [16]. Sustainability assessments examine environmental issues like air pollution and green space reduction along with social elements including housing standards and public service accessibility which affect urban living conditions [5; 15].

The expansion of urban areas stands as a critical metric for evaluating urban development because it demonstrates shifts in land use that affect both sustainability of the environment and infrastructure needs [16]. Population growth stands as the critical factor behind this expansion because rising populations necessitate more housing and essential services which guide a city's development [17] The number of available housing units functions as an important metric because it displays changes in population numbers while also reflecting economic conditions and migration patterns. Researchers such as [18] study housing growth to understand how cities adjust to these changing needs, providing valuable insights into urban expansion's economic and social effects. By examining these interconnected factors, policymakers and urban planners can develop strategies promoting balanced, sustainable growth while ensuring residents' quality of life.

While urbanization in Sulaymaniyah has been widely discussed in terms of economic and demographic impacts, there remains a noticeable gap in research that specifically investigates how this growth has affected the architectural integrity and livability of residential housing complexes. Prior studies often generalize urban development trends or overlook the perspectives of practicing architects. This study addresses that gap by applying a targeted methodology using architect-led survey data and regression analysis to quantify how rapid urban expansion has altered design quality, layout, and spatial standards. This localized and empirically grounded approach distinguishes the study from broader urban studies in the region.

The limitations of the study were both temporal and geographical, as well as related to the variety of stakeholders sampled. The research is specifically confined to housing complexes within Sulaymaniyah City that were developed after the establishment of the Board of Investment in 2006, continuing through to January 2025. This timeframe was chosen because it reflects the period of intensified investment-driven urban development that has significantly influenced architectural design in the city. As such, not all housing complexes in Sulaymaniyah are included in this study—only those constructed during this period fall within the scope. Additionally, the sampling is limited to professional architects, who possess both academic and practical expertise in evaluating architectural impacts. Their insights are especially relevant to assessing the intersection between urban growth and architectural quality.

Rapid growth in urban environments, especially in developing regions, has intensified the need for more adaptive and context-sensitive architectural approaches [1; 17]. As urbanization accelerates, cities like Sulaymaniyah face growing challenges in balancing expansion with architectural quality and sustainable planning [14; 13]. Urbanization drives both opportunities and strain—stimulating economic activity and infrastructure investment, while also leading to challenges such as overcrowding, inconsistent land use, and compromised housing standards [5; 16]. These pressures directly affect the architectural aspects of the built environment, influencing elements like façade design, spatial organization, and livability [15; 18]. In many rapidly growing cities, architectural responses often shift toward mass production and standardization, which can diminish cultural expression and long-term quality of life [19; 11]. Understanding this complex interplay between urban growth and architectural development is critical for shaping more inclusive, functional, and resilient urban housing. Based on these concerns, this study hypothesizes that rapid urban growth in Sulaymaniyah significantly impacts the architectural quality and livability of housing complexes, and that housing design plays a mediating role in this relationship.

2. Materials and Methods

This study employs a quantitative case study approach to assess the architectural impacts of rapid urban growth in Sulaymaniyah City. The research follows a cross-sectional design, collecting data at a specific point in time to evaluate current conditions and perceptions. Data collection was conducted during January 2025, using a structured questionnaire targeted at licensed architects working in the region. The research approach is grounded in a positivist philosophy, aiming to objectively measure relationships between urban expansion and architectural outcomes through statistical analysis, particularly regression techniques. This methodology was selected to generate empirical insights rooted in the professional experience of architects actively engaged in the housing sector.

2.1 Study site

This study explores how Sulaymaniyah's rapid urban expansion affects the architecture design aspects of housing complexes, emphasizing the influence of rapid growth on the quality of architectural design, to achieve this a survey is devised that investigates various impact of rapid growth emphasizing on the influence of mass production in shaping the plant layout and façade design in housing complexes. Sulaymaniyah Province was chosen as the study site and is positioned in northeastern Iraq, stands as one of the primary governorates within the Kurdistan Regional Government [19; 20]. It rests at an elevation of roughly 830 m above sea level and spans across an area of 17,023 km2. Its precise geographic coordinates are noted as 35° 33′ 40″N and 45° 26′ 14″E. The district and its divisions are depicted in Figure 1, highlighting the study’s location within Sulaymaniyah Province.

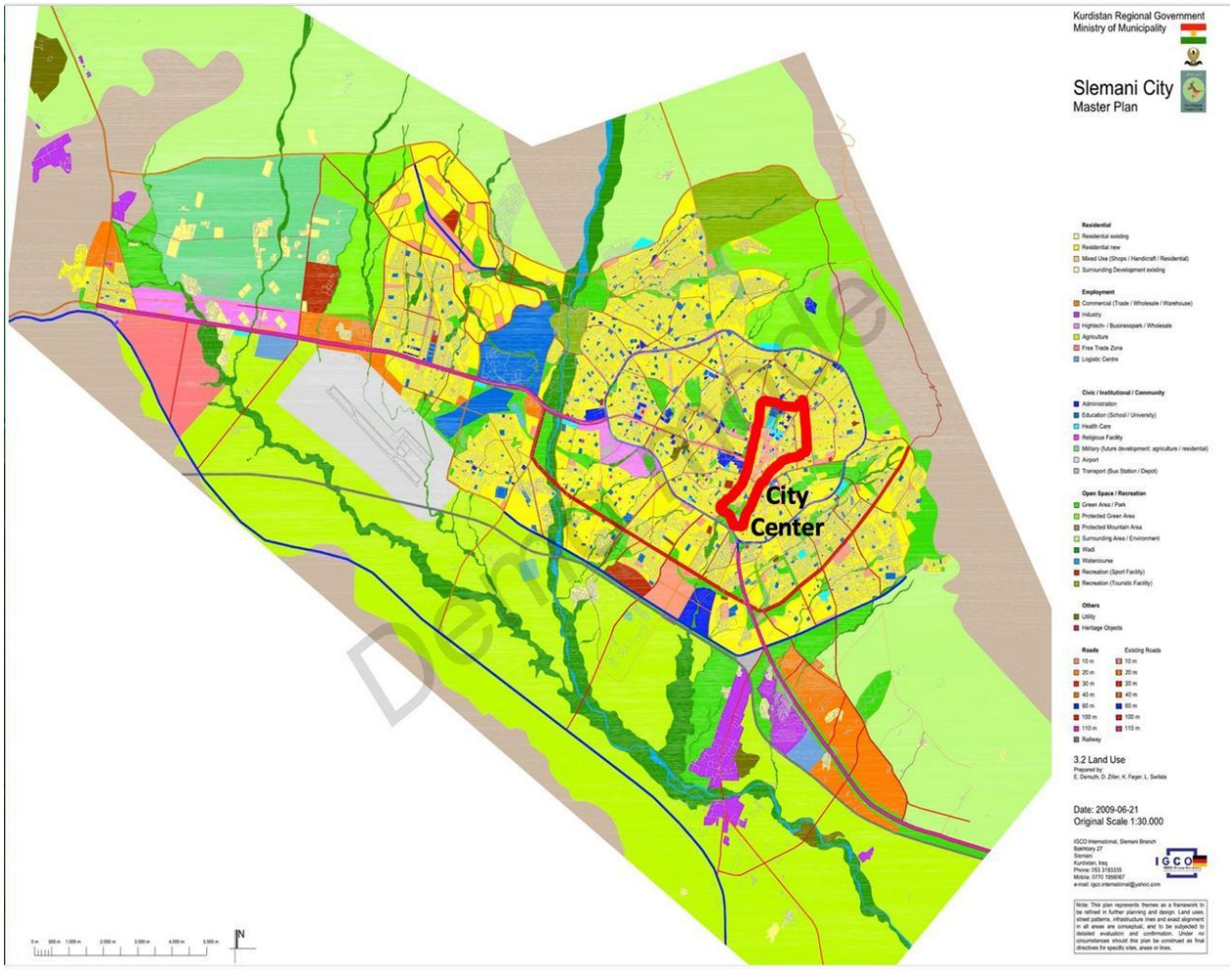

Figure 1: Study site, Iraq country, and Sulaymaniyah City

2.2 Participants and Sample Size Technique

In this study, data were collected from ninety-five architectural engineers. To ensure the survey's accuracy and reliability, a pilot study was conducted with 86 participants. Their feedback helped refine the questions, making them clearer and easier to understand. The selection of participants was carefully planned to promote fair representation and minimize bias, ensuring a balanced mix of educational backgrounds, genders, and professional experiences. By using a structured sampling approach, the study gathered insights from a diverse group, providing a well-rounded perspective on the factors driving Sulaymaniyah's rapid urban growth and its impact on housing complex design.

The research examines how urban expansion influences architectural planning, the effect of neighborhood characteristics on relocation choices, and how community interactions shape housing decisions among residents. This broad approach helps capture the social, economic, and structural dimensions of city growth, offering valuable insights into urban development and housing trends in the region.

2.3 Questionnaire Design and Data Collection

This study explores how Sulaymaniyah's rapid urban expansion influences the architecture of housing complexes, particularly in shaping design trends. To gather meaningful data, researchers developed standardized questionnaires based on a comprehensive review of existing literature. The data collection

process included face-to-face interviews with carefully selected participants, lasting about one month to ensure a detailed and diverse dataset for analysis.

Additionally, a self-administered online survey was conducted as part of this cross-sectional study, featuring thirty closed-ended questions designed to take 4–6 minutes to complete. A stratified sampling method was employed to ensure a balanced representation of perspectives, drawing participants from newly constructed housing developments and older residential areas. This approach provided a broader understanding of how urban expansion affects housing and architectural design.

The questionnaire was divided into six sections. The first section collected demographic information, including age, gender, education level, and architectural experience. The second section focused on architects' perceptions, while the remaining sections examined how urbanization impacts various aspects of housing design. To ensure accuracy and reliability, experts in architecture and linguistics reviewed the questionnaire, refining key focus areas such as Façade Design, Plan Layout and Livability, Conformance to Architectural Standards, Built-up Area, and Plot Utilization. A pilot study and content analysis were conducted before finalizing the survey to guarantee its validity and effectiveness. Only architectural engineers residing in Sulaymaniyah were eligible to participate, ensuring that responses reflected professional insights relevant to the city's urban transformation.

2.4 Ethical Considerations

Maintaining ethical standards in research requires protecting participant confidentiality and ensuring informed consent. In this study, anonymity was strictly preserved, with responses completely unlinked to individuals. Even in face-to-face surveys, forms were randomized before processing to prevent identification. Participants were fully informed about the study's purpose and scope before agreeing to take part. Voluntary participation was emphasized, with no pressure applied. A direct question, "Do you wish to participate in this survey?", confirmed consent. To uphold trust and transparency, the research followed strict ethical guidelines, prioritizing data privacy and participant rights. The study was also reviewed and approved by the Tishk International University-Sulaymaniyah Research Center.

2.5 Statistical Analysis

For statistical analysis of this data, to test the hypothesis, the regression analysis method has been employed.

3. Result and discussion

3.1 Demography

Figure 2 illustrates the demographic distribution of respondents based on age, gender, and education level. The majority fall within the 25-34 age group, while those aged 65 and above have the lowest representation. Gender distribution shows that 47% of respondents are female, while 39% are male. Regarding education, 54% hold a bachelor's degree, 28% have a master's, and 4% possess a doctorate, reflecting a highly educated participant pool.

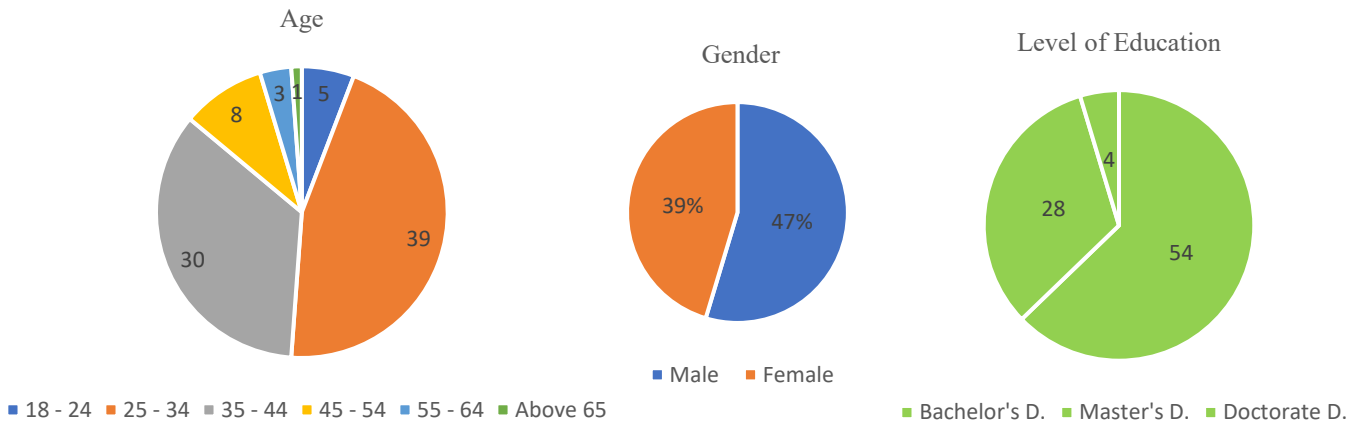

Figure 2: Responders Demography about age, gender, and level of education.

Figure 3 presents the employment status and graduation experience of the participants. As per the survey eligibility, all respondents were qualified architectural engineers. The majority are employed in the private sector, while a smaller portion work in government or are self-employed. Participants who were students at the time of the survey were excluded, ensuring consistency with the sampling criteria. The second chart shows that most participants graduated within the past 1–4 years, indicating a high representation of early-career professionals, while those who graduated more than 13 years ago formed the smallest group.

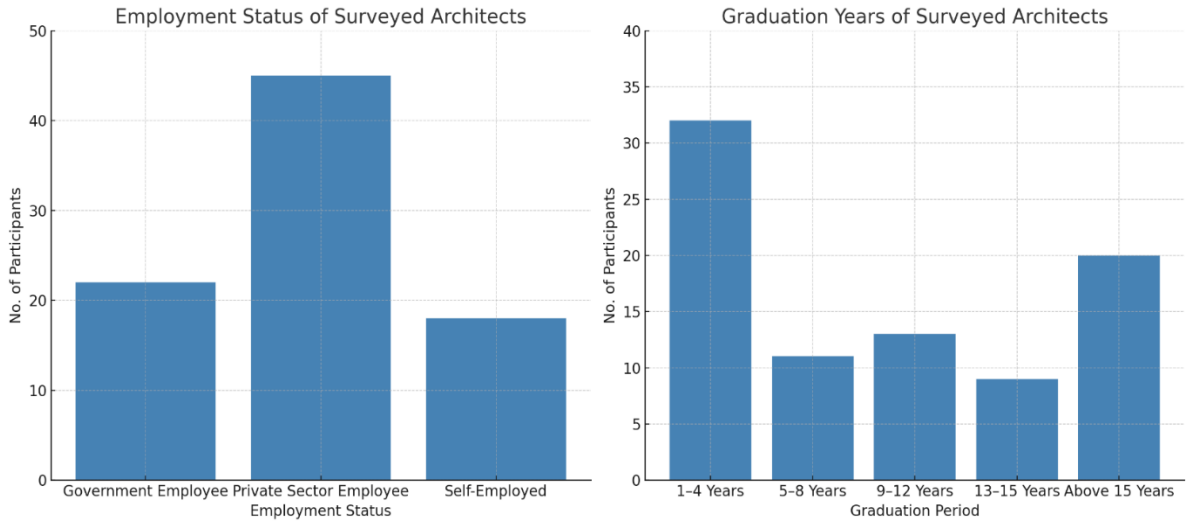

Figure 3: Employment status and graduation experience

3.2 Validity and Reliability (Architects' Evaluations)

3.2.1 Reliability

The Cronbach's Alpha for the "General Perception" section, consisting of five questions as shown in the Table 1, is 0.763, indicating acceptable internal consistency based on the social science standard of 0.7–0.8 (George & Mallery, 2003). While higher values (≥0.8) are preferable for more substantial reliability, 0.7 is sufficient for early-stage research or scales covering diverse but related aspects. Among the individual items, Question 4 has the highest corrected item-total correlation (0.407), making it the most aligned with the overall construct and crucial for scale reliability. Removing it would drastically lower Cronbach's Alpha to 0.341. In contrast, Question 2 has the lowest correlation

(0.184), suggesting weaker consistency. However, eliminating it does not significantly improve reliability, meaning its inclusion is not detrimental.

Further analysis shows that Question 4 explains the most variance, reinforcing its importance, while Question 2 has a lower squared multiple correlation, indicating weaker explanatory power. Although the scale remains reliable, refining Question 2 could enhance consistency. Overall, the Alpha value of 0.763 supports using this scale to assess perceptions of housing growth in Sulaymaniyah, especially in studies exploring broad, interrelated perspectives.

The "Façade Design" section has a Cronbach's Alpha of 0.75, indicating acceptable reliability for measuring perceptions of façade design in Sulaymaniyah's housing developments. This ensures consistency among responses, making the scale suitable for research. Question 4 has the highest item-total correlation (0.463), strongly aligning with the overall scale, while Question 2 has the lowest (0.240), showing weaker consistency. Removing Question 4 or 5 would lower Alpha to around 0.51, proving their importance. Squared multiple correlations confirm Question 4's substantial contribution, while Questions 2 and 3 are slightly weaker. Refining Question 2 could improve reliability. Overall, the scale effectively captures key aspects of façade design challenges in Sulaymaniyah.

The "Plan Layout and Livability" section has a Cronbach's Alpha of 0.70, indicating acceptable reliability for measuring housing adaptability in Sulaymaniyah's rapid growth. This meets the standard threshold for exploration research and is moderately reliable for confirmatory studies. Among the items, Question 1 has the highest item-total correlation (0.411), contributing strongly to the scale's reliability. Questions 2 and 3 also show solid correlations (0.363 and 0.367), reflecting their relevance. However, Question 4 has the lowest correlation (0.068), making it less consistent with the overall construct. Although Question 5's correlation (0.325) is lower than the strongest items, it remains within an acceptable range. Squared multiple correlations confirm that Questions 1 and 2 explain the most variance, while Question 4 contributes the least. Removing Question 4 could improve reliability, but a qualitative review is advised before making changes. Overall, the scale is reliable, though refining or replacing Question 4 may further enhance consistency.

Table 1: Cronbach's Alpha reliability analysis for survey sections on housing perceptions, including item-total correlations and the impact of item removal.

	Abbreviations	**Scale Mean if Item Deleted**	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Squared Multiple Correlation**	**Cronbach's Alpha if Item Deleted**	**Cronbach's Alpha**
General Perceptions	**GP1**	15.49	5.311	0.278	0.188	0.445	0.763
	GP2	15.58	6.019	0.184	0.072	0.499	
	GP3	15.1	5.776	0.26	0.129	0.457	
	GP4	15.79	4.226	0.407	0.234	0.341	
	GP5	15.51	5.625	0.248	0.133	0.463	
Façade Design	**FD1**	15.2	5.332	0.409	0.243	0.536	0.75
	FD2	14.72	6.948	0.24	0.163	0.613	
	FD3	15.46	5.852	0.291	0.195	0.601	

	FD4	15.55	5.537	0.463	0.309	0.511	
	FD5	15.69	5.074	0.447	0.255	0.513	
Plan Layout and Livability	**PLL1**	15.86	4.208	0.411	0.234	0.412	0.75
	PLL2	15.66	4.741	0.363	0.278	0.449	
	PLL3	15.24	5.013	0.367	0.186	0.451	
	PLL4	15.39	6.299	0.068	0.052	0.601	
	PLL5	15.25	5.221	0.325	0.134	0.476	
Conformance of Architectural Standards	**CAS1**	15.17	6.492	0.146	0.097	0.613	0.75
	CAS2	14.11	5.929	0.357	0.272	0.477	
	CAS3	13.91	5.471	0.499	0.288	0.393	
	CAS4	13.84	6.453	0.413	0.318	0.466	
	CAS5	13.81	6.066	0.258	0.203	0.54	
Built-Up Area and Plot Utilization	**BAPU2**	15.06	4.692	0.357	0.195	0.473	0.77
	BAPU3	14.7	3.923	0.549	0.408	0.346	
	BAPU4	14.9	4.265	0.488	0.416	0.396	
	BAPU5	14.67	4.166	0.531	0.454	0.371	

The "Conformance to Architectural Standards" section, with five questions, has a Cronbach's Alpha of 0.72, indicating acceptable reliability. This suggests that the scale effectively measures how rapid urban growth in Sulaymaniyah impacts adherence to architectural standards. Among the items, Question 3 (CAS3) has the highest item-total correlation (0.499), making it the most substantial contributor to scale reliability, followed by Question 4 (0.413). These two items also explain the variance within the construct the most. In contrast, Question 1 (CAS1) has the lowest correlation (0.146) and squared multiple correlation (0.097), suggesting weak alignment with the overall scale. Question 5 (CAS5) has a lower correlation (0.258) but remains acceptable.

Overall, the scale is reliable for measuring architectural standard compliance. However, refining Question 1 could improve internal consistency, making the tool more effective in assessing how urban expansion affects architectural standards in residential projects.

The "Built-Up Area and Plot Utilization" section has a Cronbach's Alpha of 0.77, indicating good reliability. This suggests that the scale effectively measures perceptions of how urbanization impacts plot utilization and built-up areas in Sulaymaniyah. With an Alpha above the 0.7 threshold, the scale is suitable for exploration and confirmatory research. Among the items, Question 3 (0.549) and Question 5 (0.531) have the highest item-total correlations, making them the most substantial contributors to reliability. Their squared multiple correlations (0.408 and 0.454) confirm their significance. Removing either would lower Alpha to 0.346 or 0.371, showing their essential role. Questions 2 (0.357) and 4 (0.488) also contribute positively but to a lesser extent. Question 2 has the lowest squared multiple correlation (0.195), meaning it explains less variance in the construct. While removing any item would decrease reliability, refining Question 2 could further improve the scale.

Overall, the scale is reliable for assessing perceptions of plot utilization in built-up areas. Minor adjustments to Question 2 could enhance its consistency with the overall construct.

3.2.2 Validity

Table 2 presents the exploratory factor analysis (EFA) results for General Perceptions of Rapid Growth, Façade Design, and Plan Layout and Livability, highlighting the impact of urbanization on housing in Sulaymaniyah. The General Perceptions section has a KMO of 0.61, with two extracted factors explaining 56% of the variance. Factor I relates to urbanization's impact on architecture and planning, while Factor II addresses challenges in aesthetics and functionality, with GP4 (long-term housing planning) being the strongest contributor. The Façade Design section, with a KMO of 0.63 and 65% variance explained, identifies two dimensions: Factor I covers standardized, repetitive designs, while Factor II focuses on cultural neglect and reduced visual appeal, with FD2 (cultural loss) rated highest. The Plan Layout and Livability section recorded a KMO value of 0.65, explaining 58% of the variance. Factor I highlights density and shared space challenges, while Factor II focuses on spatial efficiency issues. Among variables, PLL4 (spatial efficiency) had the strongest influence, while PLL1 (compactness and adaptability) had the weakest fit.

Mean values indicate general agreement among respondents, with moderate variation shown in standard deviations. The findings confirm urbanization's strong impact on housing design and livability, revealing a growing conflict between expansion needs and architectural quality. This emphasizes the need for better urban planning strategies to ensure sustainable and functional housing solutions.

Table 2: The exploratory factor analysis (EFA) results for General Perceptions of Rapid Growth, Façade Design, and Plan Layout and Livability.

	Abbreviations	Mean	Std. Deviation	KMO	Extraction	Explained Variance	Rapid growths	Housing Design
General Perceptions	**GP1**	3.87	0.97	0.51	0.61	56%	0.78	
	GP2	3.79	0.844		0.583		0.586	0.185
	GP3	4.27	0.827		0.607		0.119	0.77
	GP4	3.58	1.155		0.713		0.839	
	GP5	3.86	0.899		0.688			0.827
Façade Design	**FD1**	3.96	0.992	63%	0.596	65%	0.771	
	FD2	4.44	0.649		0.706			0.84
	FD3	3.69	0.98		0.694		0.139	0.821
	FD4	3.61	0.87		0.675		0.82	
	FD5	3.46	1.026		0.579		0.748	0.138
	PLL1	3.49	1.067	65%	0.505	58%	0.71	
	PLL2	3.69	0.95		0.716		0.776	-0.338

Plan Layout and Livability	**PLL3**	4.11	0.854		0.548		0.644	0.182
	PLL4	3.96	0.764		0.798			0.893
	PLL5	4.1	0.831		0.553		0.347	0.592

Table 3 presents the exploratory factor analysis (EFA) results for three key aspects of housing development in Sulaymaniyah: Built-Up Area and Plot Utilization, Mass Production and Architectural Creativity, and Design Quality and Errors. These findings highlight the challenges rapid urbanization poses on housing design and construction.

The Built-Up Area and Plot Utilization section, with a KMO value of 0.75, indicates strong data suitability, identifying a single factor accounting for 63% of the variance. Among the variables, BAPU5 (overutilization) is the most influential, while BAPU2 (optimization), though the least significant, still holds relevance. Mean values ranging from 3.87 to 4.26 suggest a consensus on the effects of urbanization on housing density and quality.

Similarly, the Mass Production and Architectural Creativity section, with a KMO of 0.59, also supports a single-factor structure, explaining 55% of the variance. Within this category, MP3 (loss of uniqueness in design) shows the highest commonality, while MP1 (repetitive mass housing design) has the weakest contribution but remains significant. The mean scores (3.88–4.36) indicate strong agreement among respondents regarding the negative impact of mass production on architectural creativity, further emphasizing the tension between rapid development and design innovation. The Design Quality and Errors section, with a KMO of 0.61, highlights issues in maintaining design standards, with a single factor explaining 53% of the variance. DQE2 (poor site analysis) and DQE4 (design inconsistencies) contribute the most, while mean values (3.99–4.07) show general agreement on urbanization's negative effect on design quality. Across all sections, findings emphasize the trade-offs between rapid development and architectural integrity, stressing the need for improved planning and evaluation in housing projects.

Table 3: The exploratory factor analysis (EFA) results for Built-Up Area and Plot Utilization, Mass Production and Architectural Creativity, and Design Quality and Errors,

	Abbreviations	**Mean**	**Std. Deviation**	**KMO**	**Extraction**	**Explained Variance**	**Loadings**
Built-Up Area and Plot Utilization	**BAPU2**	3.87	0.76	75%	0.593	63%	0.627
	BAPU3	4.23	0.837		0.66		0.812
	BAPU4	4.03	0.78		0.658		0.811
	BAPU5	4.26	0.774		0.674		0.821
Mass Production	**MP1**	3.88	0.867	59%	0.591	55%	0.539
	MP2	4.2	0.797		0.672		0.82
	MP3	4.36	0.618		0.681		0.825
	DQE1	3.99	0.922	61%	0.57	53%	0.685

Design Quality and Errors	**DQE2**	4.07	0.798		0.575		0.758
	DQE4	4.06	0.96		0.598		0.706

Table 4 shows the EFA results for conformance to architectural standards. The exploratory factor analysis (EFA) of the "Conformance to Architectural Standards" section examines how urban growth in Sulaymaniyah affects housing standards. The KMO value of 0.67 confirms data suitability. Two factors explain 62% of the variance. CAS4 (structural integrity issues) has the highest commonality (0.653), while CAS5 (deviation from traditional standards) has the lowest (0.529). Factor I (CAS3, CAS4, CAS5) addresses material quality and structural integrity, with loadings of 0.713–0.801. Factor II (CAS1, CAS2) focuses on proportional compromises and overall adherence, with loadings of 0.727–0.794. Mean scores (2.54–3.90) show mixed agreement. CAS1 (adherence to standards) has the lowest meaning (2.54), reflecting skepticism, while CAS5 (deviation from standards) has the highest (3.90). The EFA confirms two key factors: structural challenges and proportional compromises. The structure is valid, though refining CAS5 could improve reliability. Findings highlight concerns about urbanization weakening architectural standards.

Table 4: EFA results of conformance of architectural standards

Abbreviations	**Mean**	**Std. Deviation**	**KMO**	**Extraction**	**Explained Variance**	**Standard Challenges**	**Proportional Compromises**
CAS1	2.54	1.112		0.650		-0.139	0.794
CAS2	3.60	0.969		0.642		0.337	0.727
CAS3	3.80	0.942	67%	0.623	62%	0.713	0.339
CAS4	3.87	0.741		0.653		0.801	0.110
CAS5	3.90	1.065		0.529		0.710	-0.158

3.3 Causal Effects

The regression analysis below dissects the effects of two key dimensions: perceptions of rapid growth, city growth impacts, and poor housing design. These dimensions explain the lack of diversity within façade designs. The results below provide insight into how perceptions about rapid growth influence architectural outcomes.

3.3.1 The Impact of Housing Design and Urban Growth on Façade Diversity, Cultural Aesthetics, and Mass Production

Table 5 summarizes the effects of rapid urban growth and housing design on façade diversity, cultural aesthetics, and mass production. In Model 1, rapid growth significantly impacts façade diversity (B = 0.343, Beta = 0.347, Sig. = 0.001) but explains only 12% of the variance, suggesting additional factors are involved. In Model 2, adding housing design reduces the influence of rapid growth (B = 0.197, Beta = 0.199, Sig. = 0.049) while increasing explanatory power (adjusted R^2 = 22%), with housing design (B = 0.370, Beta = 0.376, Sig. = 0.001) proving the stronger predictor. Regarding cultural and aesthetic loss, rapid growth alone is an insignificant predictor (B = 0.194, Beta = 0.192, Sig. = 0.078,

adjusted R^2 = 4%). However, in Model 2, rapid growth becomes irrelevant (B = 0.000, Beta = 0.000, Sig. = 0.998). Housing design emerges as the primary factor (B = 0.490, Beta = 0.488, Sig. = 0.000, adjusted R^2 = 20%), suggesting that poor design choices, rather than urbanization alone, drive cultural loss. For mass production, rapid growth alone has a moderate effect (B = 0.293, Beta = 0.382, Sig. = 0.000, adjusted R^2 = 14%), but in Model 2, housing design (B = 0.212, Beta = 0.278, Sig. = 0.012) shares a similar impact, increasing explanatory power to 25%. These findings indicate that while rapid urbanization drives housing trends, design choices are more significant in determining diversity, cultural aesthetics, and mass production outcomes. Future research should incorporate economic and regulatory factors to refine these insights further.

In conclusion, housing design is stronger than urban growth in shaping façade diversity, cultural aesthetics, and mass production. Thoughtful design strategies are essential to preserving architectural identity amid rapid urbanization.

Table 5: The impact of rapid urban growth and housing design on façade diversity, cultural aesthetics, and mass production.

			Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**	**Adjusted R Square**
			B	Std. Error	Beta			
Lack of Diversity	**1**	(Constant)	2.355	0.383		6.144	0	
		Urban_Impacts_GP	0.343	0.102	0.347	3.372	0.001	12%
	2	(Constant)	1.412	0.445		3.176	0.002	
		Urban_Impacts_GP	0.197	0.104	0.199	1.963	0.049	22%
		Housing_Design_GP	0.37	0.103	0.376	3.586	0.001	
Lack of Culture and Aesthetics	**1**	(Constant)	3.298	0.409		8.071	0	
		Urban Impacts_GP	0.194	0.109	0.192	1.785	0.078	4%
	2	(Constant)	2.05	0.454		4.521	0	
		Urban_Impacts_GP	0	0.106	0	0.003	0.998	20%
		Housing_Design_GP	0.49	0.105	0.488	4.651	0	
Mass Production	**1**	(Constant)	2.975	0.296		10.056	0	
		Urban Impacts_GP	0.293	0.079	0.382	3.724	0	14%
	2	(Constant)	2.434	0.355		6.865	0	
		Urban_Impacts_GP	0.209	0.083	0.273	2.527	0.013	25%
		Housing Design. GP	0.212	0.082	0.278	2.577	0.012	
a. Dependent Variable: Lack of Diversity (FD), a. Dependent Variable: Lack_of_Cultural context_and_Aesthetics_(FD), and a. Dependent Variable: (MP)								

3.3.2 The Impact of Housing Design and Urban Growth on Livability and Architectural Challenges

Table 6 examines the effects of rapid growth and housing design on housing livability, proportional compromises, standard challenges, and vertical housing. For livability, rapid growth alone has minimal impact (B = 0.188, Beta = 0.196, Sig. = 0.072, adjusted R^2 = 4%). Still, housing design emerges as the key factor influencing livability (B = 0.342, Beta = 0.358, Sig. = 0.002, adjusted R^2 = 11%), showing that poor design, rather than urban expansion, drives livability concerns. For proportional compromises, rapid growth significantly affects housing proportions (B = 0.238, Beta = 0.220, Sig. = 0.043, adjusted R^2 = 10%), while housing design has no meaningful role, indicating that urban pressures more influence spatial adjustments than by architectural planning. For standard challenges, rapid growth has a limited effect (B = 0.239, Beta = 0.262, Sig. = 0.015, adjusted R^2 = 7%). Still, housing design is the primary factor impacting compliance with architectural standards (B = 0.353, Beta = 0.388, Sig. = 0.001, adjusted R^2 = 17%). For vertical housing, rapid growth alone has an insignificant impact (B = 0.139, Beta = 0.113, Sig. = 0.309, adjusted R^2 = 5%), yet when considered alongside housing design, urban pressures become significant (B = 0.229, Beta = 0.186, Sig. = 0.032), while poor design negatively affects perceptions of high-rise living (B = -0.227, Beta = -0.185, Sig. = 0.033, adjusted R^2 = 10%). Overall, the findings indicate that while urban expansion influences housing trends, design decisions play a more decisive role in shaping livability, structural integrity, and public perception. Addressing housing design flaws are essential for improving urban housing quality and mitigating the negative effects of rapid growth. Housing design has a greater impact on livability, proportional compromises, standard challenges, and vertical housing than urban growth. Improving design strategies is key to enhancing housing quality and mitigating urbanization's negative effects.

Table 6: An analysis of the impact of rapid growth and housing design on housing livability, proportional compromises, standard challenges, and vertical housing.

			Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**	**Adjusted R Square**
			B	Std. Error	Beta			
Livability	**1**	(Constant)	2.993	0.388		7.713	0	
		Urban_Impacts_GP	0.188	0.103	0.196	1.824	0.072	4%
	2	(Constant)	2.123	0.456		4.654	0	
		Urban_Impacts_GP	0.053	0.106	0.055	0.5	0.619	
		Housing_Design_GP	0.342	0.106	0.358	3.226	0.002	11%
	a. Dependent Variable: Livability PLL							
Proportional Compromises	**1**	(Constant)	2.193	0.437		5.018	0	
		Urban_Impacts_GP	0.238	0.116	0.22	2.052	0.043	10%
	2	(Constant)	2.327	0.545		4.272	0	
		Urban_Impacts_GP	0.259	0.127	0.239	2.041	0.044	11%
		Housing_Design_GP	-0.053	0.127	-0.049	-0.416	0.679	

	a. Dependent Variable: Proportional Compromises CAS							
Standard Challenges	**1**	(Constant)	2.951	0.364		8.117	0	
		Urban_Impacts_GP	0.239	0.097	0.262	2.476	0.015	7%
	2	(Constant)	2.052	0.421		4.869	0	
		Urban_Impacts_GP	0.1	0.098	0.109	1.016	0.313	17%
		Housing_Design_GP	0.353	0.098	0.388	3.606	0.001	
	a. Dependent Variable: Standard Challenges CAS							
Vertical Housing	**1**	(Constant)	1.565	0.513		3.049	0.003	
		Urban_Impacts_GP	0.139	0.136	0.113	1.023	0.309	5%
	2	(Constant)	2.143	0.631		3.396	0.001	
		Urban_Impacts_GP	0.229	0.147	0.186	1.983	0.032	10%
		Housing_Design_GP	-0.227	0.147	-0.185	-1.985	0.033	
	a. Dependent Variable: Vertical Housing							

3.3.3 The Impact of Rapid Urban Growth and Housing Design on Adaptability, Land Use, and Construction Quality

Table 7 examines the effects of rapid growth and housing design on adaptability, plot utilization, and design quality errors (DQE), highlighting how urban expansion and housing form shape residential development. For adaptability, rapid growth significantly increases adaptability difficulties (B = 0.333, Beta = 0.366, Sig. = 0.001, adjusted R^2 = 12%). However, housing design has a greater impact, making adaptability challenges more pronounced (B = 0.367, Beta = 0.404, Sig. = 0.000, adjusted R^2 = 25%). This suggests that while rapid urbanization adds pressure, poor housing design is the primary barrier to flexible living spaces. For plot utilization, rapid growth initially appears significant (B = 0.207, Beta = 0.238, Sig. = 0.029, adjusted R^2 = 5%), but its influence fades when housing design is considered. Housing form becomes the dominant factor in inefficient land use (B = 0.461, Beta = 0.533, Sig. = 0.000, adjusted R^2 = 24%), indicating that design choices, rather than city expansion, dictate space efficiency. For design quality errors, rapid growth moderately contributes to errors (B = 0.304, Beta = 0.344, Sig. = 0.001, adjusted R^2 = 11%). Still, flaws in housing design also play a role in lowering construction standards (B = 0.203, Beta = 0.231, Sig. = 0.041, adjusted R^2 = 15%). This reveals that rapid urbanization and poor architectural planning contribute to compromised housing quality. While urban growth pressures housing, design decisions are the key determinants of adaptability, land efficiency, and construction quality. Addressing housing form issues is crucial for creating flexible, well-planned, high-quality urban housing.

Table 7: Effects of rapid growth and housing design on adaptability, plot utilization, and design quality errors (DQE).

			Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R Square
			B	Std. Error	Beta			
Adaptability for the Residents	1	(Constant)	2.731	0.35		7.792	0	
		Urban_Impacts_GP	0.333	0.093	0.366	3.58	0.001	12%
	2	(Constant)	1.796	0.401		4.479	0	
		Urban_Impacts_GP	0.188	0.093	0.207	2.016	0.047	25%
		Housing_Design_GP	0.367	0.093	0.404	3.943	0	
	a. Dependent Variable: Adaptability PLL							
			Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**	**Adjusted R Square**
			B	Std. Error	Beta			
Built-Up Area and Plot Utilization	1	(Constant)	3.256	0.35		9.301	0	
		Urban_Impacts_GP	0.207	0.093	0.238	2.224	0.029	5%
	2	(Constant)	2.083	0.377		5.524	0	
		Urban_Impacts_GP	0.025	0.088	0.029	0.283	0.778	24%
		Housing_Design_GP	0.461	0.088	0.533	5.262	0	
	a. Dependent Variable: BAPU							
	Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**Adjusted R Square**
			B	Std. Error	Beta			
DQE	1	(Constant)	2.823	0.347		8.139	0	
		Urban_Impacts_GP	0.304	0.092	0.344	3.302	0.001	11%
	2	(Constant)	2.307	0.422		5.471	0	
		Urban_Impacts_GP	0.224	0.098	0.254	2.281	0.025	15%

		Housing_Design_GP	0.203	0.098	0.231	2.073	0.041	
	a. Dependent Variable: DQE							

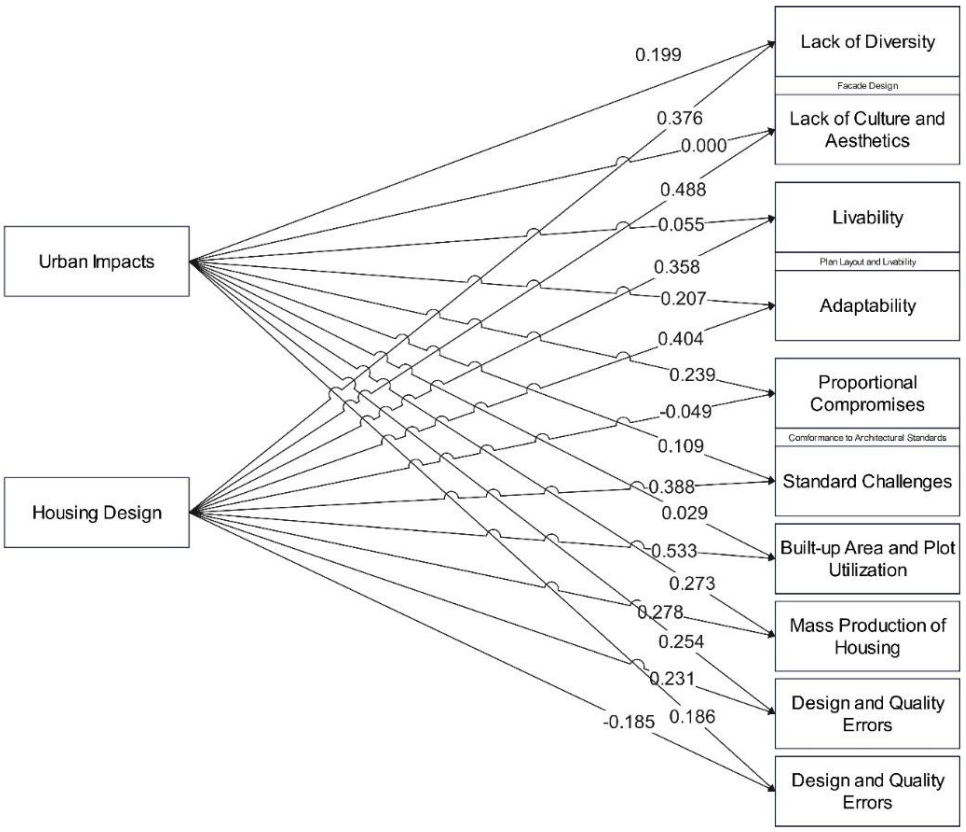

Figure 4: Causal Diagram: Impact on rapid growth of Sulaymaniyah city on the architectural aspects of Housing complexes (By Researcher)

4. Conclusion

The analysis of architectural evaluations about housing development in Sulaymaniyah presents a complex picture of city growth at a high pace and its impact on architectural aspects of housing complexes such as quality, function, and habitability. Comparing the results from the tests conducted in this methodology, one can observe that rapid growth of Sulaymaniyah city forced a balancing act between pace and quality, both in terms of integrity in terms of design and residential life in general. Causal analysis reveals strong trends in dissatisfaction, and more profound relations between rapid growth and housing design, according to descriptive statistics.

- The general perception of housing design confirms that city growth at a high velocity compromised architectural value in residential development at the expense of quality over quantity. Architects objected that excessive development compromised individuality and detail, and homeowners backed such an issue in general criticism of overall design, comfort, and usability in housing design terms. Causal analysis confirmed that rapid growth played a significant role in having a negative impact on housing design perception.
- Livability and habitability are concluded to be a major concern, with architects reporting overcrowding, access, and a lack of green spaces as concerns. Responses indicated that common spaces, light, ventilation, and controls over noise ranked amongst the least satisfactory housing

factors. Confirmatory analysis revealed rapid growth to have a significant negative impact on livability.

- The findings regarding function and layout continued to confirm that urban expansion at a cost compromised housing quality. Building architectural evaluations identified inefficient planning and loss of functional layout through rapid development.
- It was concluded that both Design and material quality were also concerns. Architects criticized the use of poor materials and rapid construction methods.

These findings support the study's hypothesis that rapid urban growth in Sulaymaniyah significantly impacts architectural quality and livability, with housing design playing a mediating role. It is recommended that further research be conducted, sampling multiple stakeholders in the housing sector. Additionally, comparative studies between various cities in Kurdistan and Iraq should be pursued to understand and quantify this issue more comprehensively.

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Authors' Contribution

Mustafa Mukhls Yuns conceptualized the study, designed the methodology, carried out data collection, and performed the statistical analysis. Amjad Muhammed Ali Qaradaghi contributed to literature review, data interpretation, and supervision of the study. Both authors approved the final version of the manuscript and are responsible for its content.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Use of AI Tools Declaration

The authors declare that any AI tools used in the preparation of this manuscript were limited to language and readability improvement only, and were not used to generate scientific content, data, analyses, or conclusions, with full responsibility retained by the authors.

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