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Original Research Article

A Comparative Analysis of the Effects of Urban Planning Regulations on the Physical Form of Urban Housing in Shiraz

(A Case Study of Low-Density Residential Areas)

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Abstract | Urban planning regulations are among the factors influencing the physical form of urban housing. By establishing construction requirements and determining how individual plots are utilized, these regulations are associated with building placement patterns and the organization of open spaces. However, understanding how such regulations are reflected in housing form requires a simultaneous examination of urban planning documents and the actual built conditions at the plot scale. This study aims to comparatively analyze the relationship between urban planning regulations and the physical form of urban housing in low-density residential areas of Shiraz, focusing on the relevant provisions of the Shiraz Comprehensive Plan, approved in 1972 (1351 in the Iranian calendar). The main research question is: How are urban planning regulations manifested in building placement patterns and the physical form of residential units? The research adopts a case study approach and comparative analysis, based on an examination of urban planning documents and regulations, as well as a field survey of 20 residential units. The samples are classified into four groups according to their physical characteristics and building placement patterns. The examined components include building coverage, building projection beyond the permitted building line, placement in relation to plot boundaries, entrance location, open space, courtyards, and light wells. The findings indicate that the surveyed cases differ in their building mass placement and the organization of open spaces. These differences can be examined in relation to factors such as building coverage, building projection, courtyard location, and light wells. The results emphasize the importance of jointly analyzing urban planning regulations, plot characteristics, and building placement patterns to understand the physical organization of housing. This approach can provide a basis for a more precise assessment of the relationship between urban planning regulations and changes in housing form, as well as for reviewing regulations in light of their spatial implications.

Keywords| *Urban planning regulations, Comprehensive plan, Physical form of residential architecture, Contemporary architecture, Shiraz*

Introduction| The transformation of residential architecture cannot be examined independently of the urban planning system, urban planning regulations, and building codes. By determining land use, density, building coverage, building placement, and the amount of open space, these regulations establish the framework within which the physical and architectural form of residential buildings takes shape. Accordingly, changes in regulations or differences in the rules governing construction may be associated with changes in building mass placement, the ratio of built space to open space, and the architectural form of buildings (Azizi, 2000). In Iran, the expansion of urbanization since the 1960s and the establishment of comprehensive and detailed urban planning systems transformed regulations concerning land use, density, land subdivision, and

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construction into instruments for guiding urban development (Azizi, 2000; Mojtahedzadeh, 2004).

Urban development plans play a role in directing urban growth and shaping the physical characteristics of the built environment through the designation of land uses, density controls, and building regulations (Saeednia, 2004; Secretariat of the Supreme ..., 2004, 84). This issue is particularly significant at the housing scale, as plot characteristics and construction requirements, including building coverage, building projection, and the amount of open space, are reflected in the placement of building masses and the architectural form of residential units (Salehi Milani, 2003). From this perspective, examining the relationship between urban planning regulations and housing form requires an assessment of how regulatory requirements are reflected at the plot and building scales.

The city of Shiraz provides a suitable context for investigating this issue. The first Comprehensive Plan for Shiraz was prepared in 1966 and approved by the Supreme Council of Urban Planning and Architecture on July 16, 1972 (Mohandesain moshaver-e ..., 1972). Under this plan, residential areas were classified according to density, and regulations were established concerning plot area, floor area, and open space. According to the provisions for low-density residential areas examined in this study, the minimum plot area per dwelling was set at 270 square meters, the maximum floor area was limited to 50% of the plot area, and the minimum required open space was established at 50% of the total plot area (Barzegar & Heidari, 2013). These requirements provide a regulatory framework for examining the physical characteristics of residential case studies. However, understanding the relationship between these requirements and the actual physical conditions of buildings requires an investigation of building mass placement, the organization of open spaces, and the location of associated spaces within residential plots.

Changes in contemporary housing form are associated not only with transformations within architecture itself but also with social, economic, managerial, and legal factors (Zarkesh, 2010). Accordingly, analyzing the physical organization of housing requires simultaneous consideration of construction requirements, plot characteristics, and building mass placement. Within this framework, examining urban planning regulations at the plot scale can provide a more precise understanding of the relationship between regulatory provisions and the spatial characteristics of residential units.

Focusing on low-density residential areas in Shiraz, this study comparatively analyzes the urban planning regulations governing residential construction and the physical characteristics of residential units. The study compares relevant urban planning documents and regulations with the physical conditions of 20 residential units, classifying the cases into four groups according to building mass placement and architectural form. The objective is to identify similarities and differences in the physical characteristics of the selected cases and examine their relationship with regulatory requirements and plot characteristics. Accordingly, the main research question is formulated as follows: How are urban planning regulations associated with the Shiraz Comprehensive Plan and residential construction related to building placement patterns and the architectural form of residential units within the study area?

Literature Review

Studies relevant to the present research can be classified into three main categories according to their research focus and scale: studies addressing the implementation and realization of urban development plans; studies examining the relationship between regulatory frameworks and the physical characteristics of the built environment; and studies investigating transformations in residential architecture and the factors influencing them. The principal findings of each category and their relevance to the present study are discussed below.

A number of domestic studies have examined the issue from the perspective of the gap between urban development policies and their implementation. Zista Consulting Engineers (1998), Azizi (2000), Sharmand Consultants (2000) and Mojtahedzadeh (2004) investigated the preparation and implementation of urban development plans and the challenges associated with their realization. Saeednia (2004) also examined the role of detailed plans in guiding urban development at different spatial scales. These studies identify the realization of urban plans as a process dependent on a range of factors associated with planning and implementation.

Azizi et al. (2012) placed greater emphasis on implementation processes, examining the roles of management structures, decision-making institutions, and the conditions affecting plan realization. The relevance of these studies to the present research lies in their demonstration that examining a planning document alone is insufficient to explain existing conditions; the process through which its provisions are implemented must also be considered.

More recent international studies have also investigated the relationship between planning regulations and the processes of land and housing development. Jalali et al. (2022), focusing on the effects of planning regulations on land and housing markets, demonstrated that regulatory constraints can influence development capacity and the allocation of land. These studies have extended the examination of regulatory consequences beyond the policy text itself to encompass the actual processes of development.

Nevertheless, the primary focus of this category of studies

has been on plan implementation and the planning process, rather than on the direct effects of regulations on the physical characteristics of individual residential units.

Another group of studies has examined the relationship between building regulations and the physical characteristics of the built environment. Salehi Milani (2003) investigated the role of building regulations in shaping the physical organization and spatial characteristics of the urban environment. Barzegar & Heidari (2013) also examined the relationship between plot characteristics, the extent of construction, and open space. These studies provide a basis for considering the plot scale and the relationship between building constraints and physical organization.

A further group of studies has investigated transformations in residential architecture by considering the range of factors influencing building form. In a study of the architecture of private buildings during the second Pahlavi period, Zarkesh (2010) examined the social, economic, managerial, and legal factors influencing architectural formation. These studies indicate that transformations in residential architecture cannot be explained solely by the internal characteristics of buildings; external factors also play a role in shaping architectural form.

From this perspective, building regulations constitute one of the institutional factors influencing residential architecture, although their mode of influence differs from that of other factors. Regulations define a range of construction possibilities and constraints. During the design and construction processes, these constraints are translated into architectural form through decisions concerning building placement and spatial organization.

A review of these three categories of studies indicates that previous research has addressed different aspects of the relationship between planning, regulations, and physical form. Studies on plan implementation have primarily examined the gap between policy and practice; studies focusing on physical form and urban morphology have investigated the relationship between regulatory frameworks and environmental characteristics; and studies of residential architecture have considered the range of factors influencing building transformation.

An aspect that requires further investigation is the direct connection between these different levels of analysis at the residential plot scale. Specifically, it is necessary to determine how a defined set of regulations, when applied to the characteristics of an individual plot, informs decisions regarding building mass placement and how these decisions are reflected in the architectural form of housing.

By placing this process at the center of its analysis, the present study moves beyond examining regulations in isolation or merely describing the physical characteristics of individual cases. Instead, it investigates the relationship between regulations, plot conditions, building mass placement, and architectural form across selected residential units. In doing so, the study seeks to bridge the gap between regulatory provisions and realized built form, demonstrating the conditions under which, and the mechanisms through which, regulations are manifested in the physical form of housing.

Theoretical Framework

• Urban planning regulations and the formation of architectural form

Urban planning regulations are among the instruments used to govern the relationship between land, construction, and the urban environment. By establishing requirements concerning land use, density, building coverage, open space, and building placement, these regulations define the framework for the physical development of plots and buildings (Azizi, 2000). From this perspective, urban planning regulations are not merely a set of quantitative restrictions. By determining development capacity and regulating the relationship between building mass and open space, they also influence building placement patterns and the architectural form of housing.

Nevertheless, the relationship between regulations and architectural form cannot be regarded as direct or deterministic. The physical implications of any regulation depend on factors such as plot dimensions and geometry, other building requirements, the compatibility of different regulations, and the manner in which the regulations are implemented. Accordingly, an analysis of the relationship between regulations and housing form should distinguish among three levels: the requirements established in urban planning documents, the actual conditions of development, and the resulting physical characteristics. This distinction makes it possible to examine discrepancies between approved regulations and existing conditions without automatically attributing every physical difference to a specific regulatory provision.

On this basis, the present study examines urban planning regulations through indicators related to development capacity and open space. Their relationship with the physical characteristics of the selected cases is then assessed by analyzing building mass placement and the organization of open spaces.

• Land plot, building coverage, and building mass placement

The land plot is the spatial unit within which building regulations are implemented, and its geometric characteristics influence the possibilities for building placement and spatial organization. Plot area, dimensions, length-to-width ratio, and location in relation to the street, together with requirements concerning building coverage, floor area, building projection, and open space, affect the development capacity and placement of building masses. Consequently, an examination

of housing form requires simultaneous consideration of regulatory constraints and the specific characteristics of each plot.

Within this framework, several concepts must be distinguished. Building coverage refers to the area of the plot occupied by the building footprint at the reference level. Floor area refers to the combined floor area of the building's storeys. Building projection indicates the extent to which a building extends in a specified direction or within a designated portion of the plot. Open space refers to the unbuilt portions of the plot, whose amount and distribution depend on building dimensions, the position of the building mass, and other relevant requirements. Although these indicators are interrelated, they should not be treated as equivalent.

The relationship between regulations and the physical organization of housing can be conceptualized through the following sequence:

Building Regulations → Plot Development Capacity and Constraints → Building Mass Placement → Physical Form of Housing

This sequence provides an analytical framework for examining the relationship between regulations and physical form; it does not imply that a definitive causal relationship between each successive stage has been established. Within this framework, uniformity in certain regulatory requirements does not necessarily produce identical physical forms. Differences in plot dimensions, entrance locations, number of storeys, and building placement can generate distinct patterns of open space and architectural form.

Therefore, the analysis of regulations in the present study is not limited to comparing quantitative building parameters. It also examines the position of building masses in relation to plot boundaries, the distribution of open space, and the relationship between entrances and the surrounding spaces of the building.

• The relationship between building mass and open space in the physical form of housing

The architectural form of housing is shaped by the relationships among enclosed, semi-open, and open spaces. In this context, building masses, courtyards, secondary courtyards, light wells, and access routes constitute interrelated elements whose placement and connections can define the spatial characteristics of a residential unit. In many traditional and contemporary Iranian housing patterns, the courtyard serves not only as an open space but also as an organizing element for access and for connections between interior spaces and the outdoor environment (Ghobadian, 2020).

From a physical perspective, the extent of construction and the location of the building mass can influence the form, position, and continuity of open space within a plot. For example, locating a building in a particular section of a plot may result in a courtyard on one side, peripheral open space, or smaller open spaces within the interior portions of the plot. However, the resulting configuration of these spaces depends not only on the extent of construction but also on plot dimensions, access organization, the number of storeys, and other design and construction requirements.

Accordingly, the relationship between building mass and open space constitutes a key link in analyzing the relationship between urban planning regulations and the architectural form of housing. Examining this relationship makes it possible to compare not only the amount of open space but also its location, configuration, and spatial distribution across residential cases.

In the present study, the architectural form of the selected cases is analyzed by examining the locations of courtyards, secondary courtyards, and light wells; access arrangements; and the relationships between these elements and the building mass. Considered alongside plot-related indicators and the extent of construction, this analysis provides a framework for interpreting physical differences among the selected cases.

• Conceptual framework for the research analysis

Based on the preceding discussion, the relationship between urban planning regulations and housing form is analyzed at three interconnected levels:

1. Plot level: Plot area, dimensions, length-to-width ratio, and requirements governing development capacity.

2. Building mass level: Building coverage, floor area, number of storeys, building projection, and the placement of the building in relation to plot boundaries.

3. Architectural form level: The location and distribution of courtyards, secondary courtyards, light wells, open spaces, and access routes, as well as their relationships with the building mass.

These levels are applied in the analysis of 20 residential units and the comparison of four groups of cases. The process begins by identifying documented regulations and indicators that can be extracted from planning documents. The physical conditions of the selected cases are then recorded through field surveys and analytical drawings. Finally, the observed similarities and differences are compared with the relevant regulatory requirements.

This framework enables the research findings to be grounded in identifiable physical evidence while distinguishing between compliance with regulations, differences arising from plot characteristics, and causal relationships that have not been empirically established.

Research Methodology

The study area is located on "Mollasadra" Street in Shiraz, Iran, and comprises 20 residential plots situated within a low-density residential zone. This area was selected because it provides an opportunity to examine the physical characteristics of residential plots, building mass placement,

and the relationship between built space and open space. Field surveys indicated that a number of plots in the area had been redeveloped in subsequent periods. Accordingly, the 20 remaining plots for which the physical characteristics could be examined were selected as the research cases. The location of the study area and the distribution of the selected plots are presented in Fig. 1. Selected field photographs of the cases will also be included, where available, to illustrate building placement patterns and their architectural characteristics.

The historical basis for examining urban planning regulations in this study is the Shiraz Comprehensive Plan, approved in 1972 (1351 in the Iranian calendar). The selection of this plan is directly related to the research objective, which is to investigate the relationship between the urban planning regulatory framework and the physical characteristics of housing within the study area. Accordingly, the regulations applicable to low-density residential areas are used as the basis for deriving the analytical indicators, thereby enabling a comparison between the prescribed requirements and the physical conditions of the selected residential plots.

Regulations Governing Low-Density Residential Areas under the 1972 Shiraz Comprehensive and Detailed Plans

1. The building volume ratio in this zone shall be 1.2 cubic metres per square metre of plot area.
2. The minimum plot area for each residential unit shall be 270 square metres.
3. The maximum floor area of a plot shall not exceed 50% of its total area.
4. Open space shall account for at least 50% of the total plot area.
5. The number of residential units shall not exceed 37 units per hectare.
6. The designated open space is intended for children's play and tree planting; therefore, its use for parking is prohibited.
7. Basement floor area shall be included in the calculation of the building volume.
8. For building projections, where both sides are open, one-half of the projected area shall be included in the calculation of floor area. Where both sides are enclosed, two-thirds of the projected area shall be included. If all sides are enclosed by walls, screens, or glass, the entire area shall be counted as floor area.
9. Where the ground floor is connected to the associated open space to provide additional open space and accommodate parking, this area shall not be added to the total floor area.
10. Where a secondary courtyard is required within a building, it may be provided only if its area is not less than 7% of the total plot area or less than 20 square metres (Mohandesain moshaver-e ..., 1972).

Later comprehensive and detailed plans have not been used as the primary basis for the present analysis, since the objective is to assess the physical conditions of the selected cases in relation to the historical regulatory framework under examination, rather than to compare all periods of urban planning in Shiraz. Nevertheless, as planning regulations may have changed over time, determining the extent to which each plot conforms to the 1972 regulations requires consideration of its construction date, subsequent physical alterations, and relevant documentary evidence. Accordingly, the analysis distinguishes between the historical regulations under investigation and regulations introduced in later periods. The existing physical characteristics of the selected plots are not attributed conclusively to the 1972 plan in the absence of sufficient supporting evidence.



Fig. 1. Zone of case study. Source: Authors.

Research Findings

The examination of 20 residential units located in a low-density residential area of Shiraz, focusing on plot characteristics, building mass placement, and the spatial organization of buildings, resulted in the identification of four physical patterns. Group A comprises single-storey residential units with north-facing entrances and direct access to the building. Group B consists of two-storey units with north-facing entrances and direct access to the building. Group C includes units with north-facing entrances and open parking areas, while Group D comprises units with south-facing entrances and access to the building through a courtyard. Each group contains five cases, resulting in a total sample of 20 residential units (Table 1).

In terms of plot dimensions, the areas of the selected cases range from approximately 212 to 278 square metres. Although all cases are located within the same residential zone, they differ in building coverage, floor area, number of storeys, building projections, open space, secondary courtyards, and parking arrangements. These variations are also reflected in the distribution of building mass and open space within individual plots.

• Degree of compliance with the regulations under examination

Regulation 1: The building volume ratio in this zone shall be 1.2 cubic metres per square metre of plot area.

The results of comparing the physical characteristics of the 20 cases with the regulations under examination are presented in Table 2. The comparison indicates that the degree of compliance varies across the different indicators. The highest level of compliance relates to the regulation governing the number of residential units, whereas greater discrepancies between regulatory requirements and observed conditions are evident in indicators such as building coverage, open space, building projections, and secondary courtyards.

The percentages reported in Table 2 were calculated as the proportion of cases complying with the relevant regulation out of the total sample of 20 residential units. Accordingly, each indicator was assessed independently, and its compliance rate was calculated in relation to the corresponding regulatory requirement. This approach provides a consistent basis for comparing the extent to which different regulatory provisions are reflected in the same sample.

- Building coverage and open space

Regulation 3: The maximum floor area of a plot shall not exceed 50% of its total area.

Regulation 4: Open space shall account for at least 50% of the total plot area.

One of the principal indicators examined is the relationship between building coverage and open space within each plot. Under the regulations under consideration, 50% of the plot area is allocated to the permitted building area, while the remaining 50% is designated as open space. Comparing this prescribed ratio with the existing conditions of the selected cases reveals variations in the distribution of building mass and open space. In some cases, open space is distributed around the building, whereas in others, most of it takes the form of a courtyard or a clearly defined open area on one side of the plot.

Consequently, the ratio of building coverage to plot area alone is insufficient to explain the spatial organization of the

Table 1. Comparison of building groups in relation to the 1972 Shiraz Planning Regulations. Source: Authors.

Group	Predominant Plot Characteristics	Number of Storeys	Building Coverage	Floor Area	Building Projection	Open Space	Building Placement Pattern	Predominant Physical Pattern
A	Plots of moderate dimensions and area	1	Low to moderate	Low	Limited	Extensive	Building positioned in the northern part of the plot, creating a courtyard to the south	Courtyard-oriented layout with extensive open space
B	Plots with greater width and larger area	1–2	Moderate	Moderate	Moderate	Moderate	Greater building projection, accompanied by a relative reduction in open space	More compact building mass with a southern courtyard
C	Plots with dimensional constraints or narrower widths	2	Moderate to high	Moderate to high	Greater	Limited	Increased building mass and reduced open space to accommodate floor area requirements	Compact building mass with limited open space
D	Plots with varying dimensions and regulatory conditions	2–3	High	High	Extensive	Limited	Denser building placement and maximum utilization of the plot's development capacity	Dense, multi-storey configuration

Table 2. Physical characteristics of the selected residential units (Note: A dash (-) indicates that no value was reported. Source: Authors' field survey and measurements.). Source: Authors.

Group	Case No.	Plot Area (m^2)	Building Coverage (m^2)	Floor Area (m^2)	Building Projection (m^2)	Secondary Courtyard (m^2)	Number of Storeys	Parking Spaces
A	1	212	139	139	2.5	-	1	1
A	2	270	135	135	-	3	1	1
A	3	274	164	164	5	6	1	1
A	4	230	110	110	2.5	-	1	1
A	5	250	125	125	3	-	1	1
B	1	215	135	170	3	-	2	1
B	2	270	170	340	-	-	2	1
B	3	270	135	260	-	-	2	1
B	4	212	110	220	2	-	2	1
B	5	273	145	295	5	-	2	1
C	1	260	150	150	5	4	1	1
C	2	256	130	130	5	3	1	1
C	3	270	135	135	6	5	1	1
C	4	278	160	160	6	7	1	1
C	5	270	150	150	7	6	1	1
D	1	270	135	135	5	5	1	2
D	2	275	135	135	4	6	1	2
D	3	270	165	165	5	6.3	1	2
D	4	215	140	140	3	6	1	1

cases. The position of the building mass within the plot also plays a role in determining how open space is formed and arranged. This distinction is also evident in the four physical patterns identified in the study.

- Building projections and building mass placement

Regulation concerning basements: Basement floor area shall be included in the calculation of building volume.

Regulation concerning building projections: Where both sides of a building projection are open, one-half of its area shall be included in the calculation of floor area. Where both sides are enclosed, two-thirds of its area shall be included. If all sides are enclosed by walls, screens, or glass, the entire area shall be counted as floor area.

In addition to building coverage, building projection is another indicator affecting the placement of a building within its plot. According to the implementation provision examined in this study, the permissible building projection is determined on the basis of 60% of the plot length. By contrast, the regulation governing building coverage sets a limit of 50% of the total plot area. These two provisions therefore rely on different parameters to control building development.

The comparison of the selected cases indicates that variations in the extent of building projection are accompanied by differences in building mass placem.

- Courtyard

Regulation 9: Where the ground floor is connected to the associated open space to provide additional open space and accommodate parking, this area shall not be added to the total floor area.

Regulation 10: Where a secondary courtyard is required within a building, it may be provided only if its area is not less than 7% of the total plot area or less than 20 square metres.

The examination of the selected cases revealed that secondary courtyards are not present in all the residential units studied. Even among cases where a secondary courtyard has been provided, its dimensions are not consistent, and some cases do not comply with the minimum requirements of the regulations under examination. Therefore, secondary courtyards do not follow a uniform pattern across the sample; their presence, dimensions, and location vary according to building mass placement and plot characteristics.

These variations are also reflected in the architectural form of the cases. In some residential units, open space is primarily organized as a main courtyard, whereas in others, secondary courtyards and lateral open spaces play a more prominent role in the organization of the plot.

- Number of storeys, entrance location, and the relationship between the building and open space

Regulation 5: The number of residential units shall not exceed 37 units per hectare.

Regulation 6: The designated open space is intended for children's play and tree planting; therefore, its use for parking is prohibited.

The examination of the four physical patterns revealed that the number of storeys and the location of the entrance are among the factors contributing to differences in the relationship between buildings and open space. In Group A, single-storey buildings have north-facing entrances and direct access to the building. In Group B, the buildings are two storeys high, while the pattern of direct access from the north is retained. In Group C, the provision of open parking allocates part of the plot to vehicle parking and access. In Group D, the entrance is located on the south side, and access to the building is provided through a courtyard.

Consequently, although all cases are situated within a regulated residential zone, the relationships among the entrance, building mass, open space, and parking are not uniform. These differences form the basis for classifying the selected cases into four distinct physical groups.

Overall, the examination of the 20 cases indicates that the degree of compliance with the regulations under consideration varies across the different indicators. The number of residential units exhibits the highest level of compliance, whereas building coverage, open space, building projections, and secondary courtyards show greater discrepancies between the prescribed requirements and existing conditions.

Furthermore, the cases can be distinguished into four physical patterns based on building mass placement, the ratio of built space to open space, entrance location, number of storeys, and parking arrangements. The field survey data therefore indicate that the implementation of the regulations at the plot and building scales has not resulted in entirely uniform physical patterns among the cases studied. This finding provides the basis for examining the relationship between the regulations under consideration and building placement patterns in the Discussion and Analysis section of the study.

Based on the data obtained from the 20 residential buildings, the cases were classified into four main groups to examine the nature and effects of the regulations established in the Shiraz Comprehensive Plan for low-density residential areas. The results are presented in Table 3 & Fig. 2. The rows of the table represent the ten implementation regulations governing low-density residential zones, as specified in the resolutions of the Supreme Council of Urban Planning and Architecture under Shiraz's first Comprehensive Plan. The columns correspond to the individual cases presented in Table 1. The grey-shaded cells indicate compliance with the relevant regulation in each case.

Conclusion

This study aimed to examine the relationship between urban planning regulations and the physical organization of residential units in a low-density residential area of Shiraz, Iran. To this end, the physical characteristics of 20 residential units were compared with the regulations under examination in terms of plot characteristics, building coverage, building mass placement, open space, secondary courtyards, number of storeys, entrance location, and parking arrangements.

The findings indicate that the degree of compliance with the regulations varies across the different indicators. Among the indicators examined, the regulation governing the number of residential units exhibited the highest level of compliance. By contrast, greater discrepancies between the regulatory requirements under examination and the observed physical conditions were identified in indicators such as building coverage, open space, building projections, and secondary courtyards. These differences suggest that regulatory compliance cannot be assessed uniformly across all dimensions of residential form.

The comparison of the selected cases also led to the identification of four physical patterns based on the number of storeys, building mass placement, entrance location, and the relationship between the building and open space. The differences among these patterns indicate that the spatial organization of residential units depends not only on the extent of building development but also on how built mass and open space are distributed within each plot. For example, similar levels of building development on two plots do not necessarily result in comparable spatial organizations, as the location of the building mass and the configuration of open spaces may differ.

In response to the main research question, the findings suggest that urban planning regulations establish a framework for shaping the physical form of housing by defining the limits and requirements of building development. However, the observed physical conditions of the selected cases emerge from the interaction between these requirements, plot characteristics, and building placement. Therefore, analysing the relationship between regulations and residential form requires the simultaneous examination of regulatory compliance and its spatial implications at the plot scale.

Given that the study is limited to 20 residential units within the selected study area, the findings should be generalized to other residential zones in Shiraz with caution. Furthermore, explaining the historical relationship between the regulations and the existing physical conditions requires consideration of the construction and redevelopment dates of the residential units, as well as the regulations in force during their development. Accordingly, rather than establishing a causal relationship between a specific regulation and the final form of a building, the findings emphasize the importance of a comparative analysis of planning regulations and the resulting built conditions for understanding the spatial organization of urban housing.

Conflict of Interest

The authors declare no conflict of interest regarding this study.

Table 3. Compliance of the selected residential cases with the regulations of the 1972 Shiraz Comprehensive Plan. Source: Authors.

No.	Regulations under Examination	Group A: No. of Plans	Group A: Percentage	Group B: No. of Plans	Group B: Percentage	Group C: No. of Plans	Group C: Percentage	Group D: No. of Plans	Group D: Percentage	Mean
1	The building volume ratio in this zone shall be 2 cubic metres per square metre of plot area.	2	40.00%	5	66.67%	5	16.67%	2	40.00%	33.39
2	The minimum plot area for each residential unit shall be 270 m^2.	3	60.00%	2	33.33%	4	13.33%	3	43.33%	39.97
3	The maximum floor area of a plot shall not exceed 50% of its total area.	0	0.00%	0	0.00%	5	50.00%	5	16.67%	13.33
4	The maximum floor area of a plot shall not exceed 50% of its total area.	0	0.00%	0	0.00%	6	20.00%	0	0.00%	7.33
5	Open space shall account for at least 50% of the total plot area.	2	40.00%	5	66.67%	5	16.67%	2	40.00%	39.31
6	The number of residential units shall not exceed 37 units per hectare.	3	60.00%	2	33.33%	4	13.33%	3	43.33%	29.97
7	The designated open space is intended for children's play and tree planting; therefore, its use for parking is prohibited.	0	0.00%	0	0.00%	3	50.00%	5	16.67%	13.33
8	Basement floor area shall be included in the calculation of building volume.	0	0.00%	0	0.00%	6	20.00%	0	0.00%	6.66
9	Where both sides of a building projection are open, one-half of its area shall be included in the floor area calculation. Where both sides are enclosed, two-thirds shall be included. If all sides are enclosed by walls, screens, or glass, the entire area shall be counted as floor area.	5	40.00%	5	66.67%	5	16.67%	5	40.00%	39.33
10	Where the ground floor is connected to the associated open space to provide additional open space and accommodate parking, this area shall not be added to the total floor area.	8	40.00%	20	66.67%	5	16.67%	12	40.00%	39.33
11	Where a secondary courtyard is required, its area shall not be less than 7% of the total plot area or less than 20 m^2.	12	60.00%	10	33.33%	4	13.33%	13	43.33%	29.97

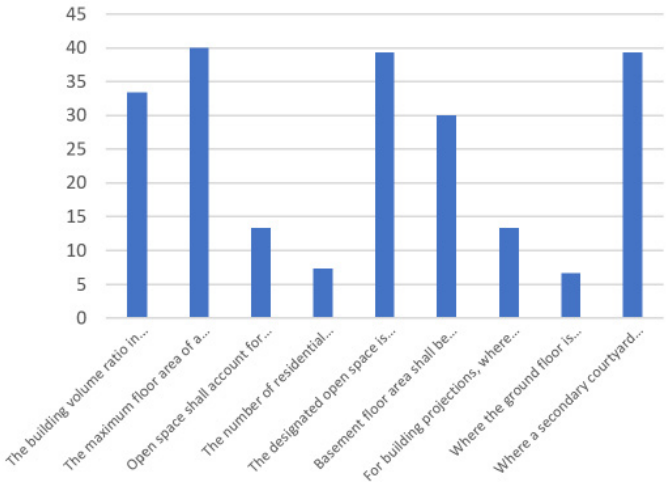


Fig. 2. Chart derived from the data in Table 2. Source: Authors.

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