

Research Article

Comparison Of Traditional And Modern Housing Designs Under The Influence Of Global Climate Change (Talas Example)

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Abstract

All over the world, climates are changing due to various reasons, and there is an increase in natural disasters. Increasing disasters bring economic, social and environmental losses along with loss of life. It is important to study the disaster architecture and develop recommendations due to climate change in countries such as Turkey, where the construction sector is constantly dynamic and developing. The aim of study is to evaluate traditional and modern housing properties in terms of climate resistance and to make housing design proposals to prevent the damage caused by disasters to structures. The scope of the study consists of the Talas district, Kayseri, which has become the center of Central Anatolia. The high rate of housing production, the frequent occurrence of natural disasters in recent years, and the greater damage to newly designed houses from disasters have been effective in determining the study sample area. The study was conducted to investigate the effects of disaster resilience, stability, concept and building elements in architecture.

Keywords: Climate Change, Natural Disaster, Disaster and Design, Disaster Damages, Housing Design.

1. Introduction

Climate can be defined as the average situation obtained by observing all weather events, atmospheric processes, extreme formations and average values over many years [2]. As in the whole world, climates are changing rapidly in our country due to various reasons. The main reason for these changes is the deterioration of the radiation balance on the earth [3]. With the development of the industrial sector since the 19th century,

the increase in energy consumption in the world countries (especially the use of fossil fuels) and other human factors (land use changes, deforestation, etc.) have caused the accumulation of greenhouse gases in the atmosphere and caused the energy balance of the planet to deteriorate [1]. The deterioration of this natural balance on earth causes climate change, triggering many disasters such as landslides, floods, hurricanes, melting of glaciers, and consequently negatively affecting nature and human life [8]. Disasters are inevitable, people need to accept this problem and learn to live with it by approaching it with a solution [12]. These disasters, which were seen as acts of god that could not be prevented in historical times, started to be seen as natural events with the development of science. Today, it is clearly seen that society is human action. In this context, natural disasters will continue to occur, but the fragilities of the built environment should be tried to be minimized thanks to the concept of durability [11]. Planning, building design and implementation processes are of great importance in reducing the effects of natural disasters. The effects of natural disasters should be evaluated in the architectural design process, and safe living environments should be designed by taking into account the changing climatic conditions. It is also important that the members of the society and the managers take the necessary precautions [10]. Based on this view, an answer was sought to the question of what are the criteria for resistance to changing climatic conditions. In the study, Talas district of Kayseri province was chosen as the sample area. In this study, modern and traditional houses were evaluated in terms of resistance to climate. With the findings obtained in the study, it is aimed to contribute to the new designs being more sensitive and resistant to nature, the environment and disasters.

2. Materials and Methods

The aim of the study is to provide an understanding of the different but interrelated factors related to the promotion of disaster-resistant housing. In this context, comparative analyzes were adopted and the strength characteristics and architectural qualities of the houses were examined as much as possible during the field visit. After collecting data in the field, analyzes were made based on literature data in terms of composition, material, technology, suitability, and sustainability. In this study, only local housing structures were examined and suggestions were developed in line with sustainability, social and economic environmental aspects. The flowchart of the method followed in the study is shown in Table 1.

Table 1 Method flow chart.

DATA COLLECTION

WORKSPACE REVIEW	LITERATURE REVIEW
(Examining of Traditional and Modern Housing Features)	(Examining Definitions of Climate, Climate Change, Natural Disaster, Housing Design)
A COMPARISON OF MODERN AND TRADITIONAL HOUSING	
ANALYSIS AND DEVELOPMENT OF DESIGN PROPOSALS	

3. Working Area

The province of Kayseri, which constitutes the sample area of the study; It is located in the Central Kızılırmak section, where the southern part of Central Anatolia and the Taurus Mountains intersect [27]. Kayseri, which is the third largest city and industrial center of Central Anatolia after Ankara and Konya, has 16 districts, mainly Kocasinan, Melikgazi and Talas [28, 29]. Talas district is 8 km from the center of Kayseri (Figure 1). It is located on the northeastern skirts of Erciyes Mountain in the southeast. Talas district (altitude ~1100 m), which is 50 meters above the center of Kayseri, is one of the important recreation areas of Kayseri [16]. In determining the scope of the study, the high rate of housing production, the frequency of natural disasters, and the fact that new design houses were damaged more due to disaster events in the district, where both traditional and contemporary houses are located, were effective.



Figure 1. Kayseri district map [32].

4. Analysis of current situation

The first settlement activities in Talas, which has a history of 2000 years in terms of settlement characteristics, coincide with the first years of AD. Since the region is a cinder cone formed by volcanic activities, the land has a tuff structure and the workability of this structure has been the primary reason for choosing Talas for

settlement. For the purpose of shelter and defense, rock-cut spaces were first settled on slopes and valleys (Figure 2). It is striking that there is a significant increase in construction in the district, which has the opportunity of a large settlement area. Multi-storey (usually 10 floors and above) construction is dominant throughout the district, and there are lower-rise buildings in the old settlements [9, 14, 24, 30]. According to the data in Talas Municipality's Activity Report for 2020, the total park area in Talas is 668,282 m². The rate of green space per capita is limited due to the low utilization of green areas on its lands. Talas, which has suitable areas for investment, also has suitable areas for agriculture [31].



Figure 2. General view of the traditional housing texture of Talas district [17].

4.1.Climatic Condition

In Talas District, terrestrial and steppe climate characteristics are dominant like Kayseri province. Compared to Kayseri, it has lower temperatures in summer due to its higher elevation (about 50m). While rain is mostly seen in the spring and autumn seasons, the least rainy months are July and August. Strong winds are seen in Talas especially in the spring and autumn seasons. While winds generally blow from south to north, strong winds blow from east and southwest [14, 15, 17]. Some meteorological average values based on the last sixty years of observations for the province of Kayseri are given below (Table 2).

Table 2. Meteorological Indicators [26].

The Highest/ Lowest Temperature (°C)	40,7/-28,4
Average Frosty/Rainy/Snowy Day	125/106,9/34
Average Sun Exposure (hours/minute)	6,8
The Prevailing Wind Direction	South
Altitude(m)	1094

4.2.Kayseri province- Talas district traditional housing analysis

Talas is an important residential area bearing the traces of the traditional housing culture of the region. 3 different protected areas have been registered within the protected area of Talas region by the "Kayseri Cultural and Natural Heritage

Preservation Board". The urban protected area constitutes the largest area within the Talas protected area and includes residences, mosques and churches. Secondly, it is the natural site that defines the steep slope separating the upper and lower Talas. Third, it is the archaeological site that defines the underground cities in the region. In addition to these, there are also protection areas at the scale of a single building. Many factors have been effective in shaping the Traditional Talas residences, which constitute the urban protected area, which is the largest protected area of Talas. The main ones are user-related factors, natural and built environment-related factors, and economic factors [6]. Considering the traditional Talas residences shaped in the these factors; The first settlement activities emerge with rock-cut spaces due to the tuff rocky soil feature of the region (Figure 3) [14]. The residences, which are mostly built as two storeys, are located on the sloping land of Talas. The reason for this in the first settlements; to meet their shelter and defense needs. The positioning of the house and its relationship with the slope have been shaped according to the orientation towards the view [24] (Figure 4).



Figure 3. Talas rock carved places [9].



Figure 4. Traditional Talas houses located on sloping land [4].

The stone material reserves in region have shaped the material and construction system used in traditional houses. Wooden material was used in the floors and ceiling beams of the buildings produced in the masonry system using stone material. A characteristic texture specific to the region was formed by the use of local materials. Another characteristic feature of Talas houses is that one of their facades defines the street. It is seen that traditional buildings are directly related to the street. The two-wing doors opening to the street and the upper floor exits form the street silhouette (Figure 5). The gardens of the adjacent buildings are located at the back of the houses [23]. They carried the water necessary for viticulture activities through water channels. There are also wells and cisterns to collect water (Figure 6). Landscape elements used in gardens are also used for protection from environmental factors. When the functional features and typological data of Talas houses are evaluated; Although there are plan types

influenced by various cultures, it has been determined that the main floor is generally located on the upper floors that are not related to the street. The size of the house and the number of rooms have developed in proportion to the size of the family. Talas houses, which are shaped according to the parcel they are in, vary in size, ornament and showiness according to the economic situation [6].



Figure 5. Talas residential texture created using wood and local stone materials. [4].



Figure 6. Traditional Talas water wells [4].

The spatial arrangements are generally inward-looking, shaped around the courtyard or garden (As in traditional Turkish houses). The house is located on the south-facing side of the courtyard. Generally, the house consists of the summer section located on the north and upper floor of the house and the winter section located on the south and lower floors of the house. In some houses, there is an intermediate floor with a lower ceiling height between the ground floor and the upper floor, which is mostly used for winter, not in the whole house, but only above a single space such as a barn or tokana. On the roofs of some large houses, there is a pavilion floor, mostly in small square form, with windows in four directions, overlooking the view, to be used in the hot time of summer [23]. Spaces are divided into two groups in terms of their functional features. First, actions such as sitting, lying, and washing are performed together in the sections called rooms. The second one constitutes units such as cellar-cold room, kitchen, barn, where food is stored, which are called service spaces [24] (Figure 7).

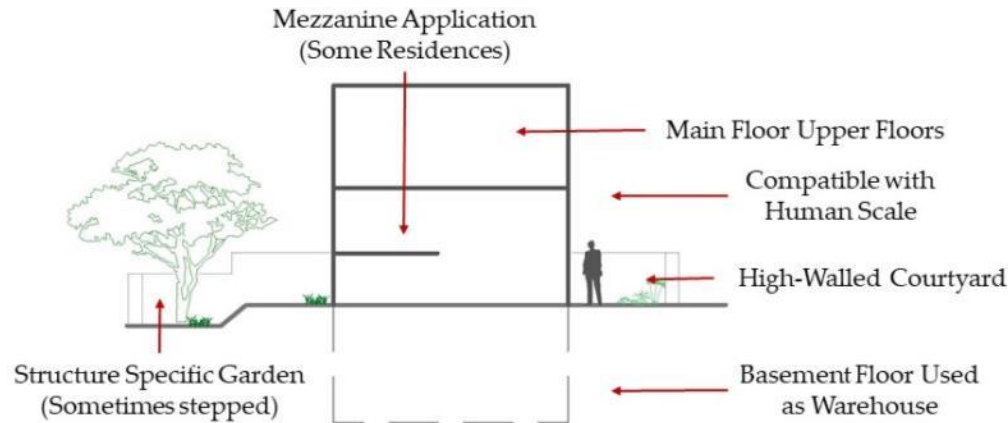


Figure 7. Traditional Talas house.

Climate data has been highly influential in shaping the Talas housing culture. The following ecological features have been determined in the traditional architecture of the region, which is sensitive to nature and shaped according to climatic conditions. These;

- ✓ The building envelope is made of heavy materials with high heat retention.
- ✓ The buildings are built as a masonry system with stone building materials, which have reserves in the region (As the stone material, basalt stone, which has a high heat storage capacity, heavy, dense and non-porous structure, was preferred).
- ✓ Square and rectangular planned forms were used to reduce heat loss (Figure 8).
- ✓ With the use of wood-stone materials together, heat preservation is aimed with composite walls of 50-60 cm and more thickness.
- ✓ In general, the roofs of the buildings in the region are covered with wood or stone on circular cross-section wooden beams, and on top of that, a roof made of mortared, compressed earth compatible with climate conditions is preferred. The water accumulating on the roof is transferred to the street with gargoyles (Figure 8).
- ✓ The sun is the primary factor in shaping the houses. Wet areas face north, main living spaces face west or south, which is the landscape direction, and bedrooms face east.
- ✓ On the facades (especially the north facade) where heat loss will be experienced more, the number of windows is low and their area is small (Figure 9).
- ✓ Although the landscape situation is taken into account in the orientation, the west direction is preferred in the settlements on the slope (Figure 10).
- ✓ In winter, the entrance doors are located in the direction (south-east) where the sun's rays come to the building, in order for the snow in front of the entrance door to melt quickly.



Figure 8. An example of traditional housing in which square forms are used Traditional house facade with gargoyles [4].



Figure 9. Less use of window openings on the northern facades of traditional Talas residences [4].

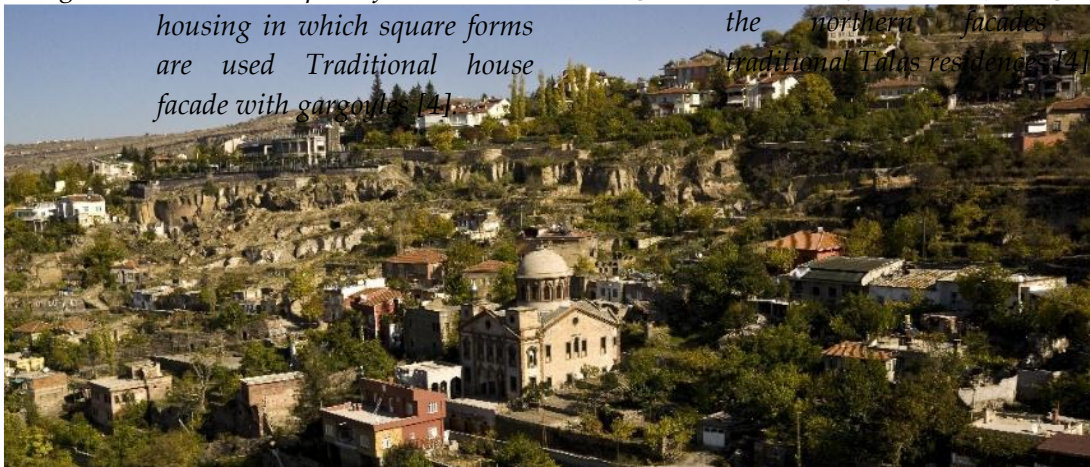


Figure 10. Street texture of Talas district, located on the slope [24].

- ✓ The settlement consists of adjacent nizam (for blocking heat loss and wind protection) and narrow streets (for wind protection) (Figure 11)
- ✓ The plan scheme extending in the east-west direction allows the sun to extend into the interior.
- ✓ Large window openings are located on the west façade due to the view and sunbathing.
- ✓ Windows are protected against external influences by means of shutters or covers placed outside the building (Figure 12).
- ✓ In spaces with a ceiling height of more than 3.50 meters, there are star windows above the windows for ventilation and lighting function (Figure 13).
- ✓ While natural ventilation is provided by windows and star windows, small grooves are opened between the floors and the circulation of the air within the building is ensured [6, 24].



Figure 11. Talas district traditional street texture [4].



Figure 12. Measures taken to protect windows against external influences [4].



Figure 13. Star window use in traditional Talas residences [4].

Examples of traditional Talas dwellings that are sensitive to climate, whose features are mentioned above, still exist today. The main ones are; Yaman Dede Mansion, Ali Saip Paşa Mansion, Yaren House, Akşehirlioğlu Mansion.

4.3. Analysis of modern housing in the Talas district of Kayseri province

Two different types of housing are commonly seen in the construction in Talas. One of them is the mass high-rise residential buildings established on the plain surface in Lower Talas; the other is the luxury villa type summer buildings that are commonly seen on the slopes of Yukari Talas and Ali Mountain [14]. Especially in the area where high-rise buildings are located, unhealthy residences have been produced, which are far from traditional architecture, not fused with environmental factors and cultural texture,

with the effect of rapid construction and developing technology. In addition, slum development, distorted and unplanned development, earthquake-resistant construction, social (green space, education, health, sports facilities, etc.) in the city and physical - spatial problems such as lack of technical infrastructure have also manifested themselves with migrations [6]. Modern houses, which are built using contemporary construction technologies and popular materials evaluated under several headings in terms of climatic design parameters.

4.3.1. Settlement scale; site selection and building spacing

Usually, new houses that develop in a discrete order are open on all four sides and are unprotected against external influences. The high blocks, built on flat terrain, contradict the old residential texture, consisting of two-story courtyard houses (Figure 14).

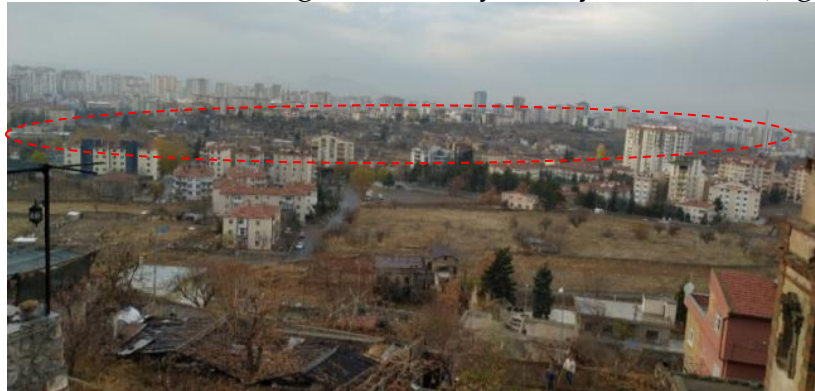


Figure 14. The contradiction of traditional and modern Talas housing texture [4] .

Indoor comfort conditions cannot be provided, especially because the upper floors of high-rise buildings receive excessive sun in the summer. In addition, in high-rise residences located at a close distance, there is a need for more heating, especially since sunbathing is prevented on the lower floors (Figure 15).



Figure 15. The fact that today's Talas residences are located close to each other negatively affects the sunbathing effect [4].

While determining the layout, the movement of the sun was not taken into account, and the prevailing wind direction of the city was not taken into account. Settling without paying attention to the prevailing wind direction, being high-rise buildings and arranging them without considering the distance-floor height relations between the houses, increases the speed of the wind and causes the houses to be affected more. The high-rise blocks built around the houses with courtyards that are low in height, as well as blocking the sun and wind of these houses; It also damages the functions of courtyards used during the day in summers [6].

4.3.2. Building scale; orientation and form

Roofs in new buildings are usually in the form of a hipped roof. Although roofs shaped with various slopes replace the flat roof used in traditional Talas houses, which are very suitable for hot-dry climate regions, they cannot fulfill the same function. The types of hipped roofs made with current construction methods and materials remain weak in the face of wind load in the region. User comfort is adversely affected by the failure of the selected roof type to adapt to climatic conditions and the negligence in the application point of the roof, creating material and moral problems in the usage process (Figure 16).



Figure 16. Application of hipped roof in modern Talas houses [4].

4.3.3. At the scale of the building element; building envelope and solar control – natural ventilation systems

Today's Talas residences are built with reinforced concrete systems that do not have heat retaining properties, and pumice and perforated brick are used as exterior wall material. PVC window systems with sealed systems are also used in Kayseri and Talas in order to be protected from external environmental conditions. This prevents the house from breathing, causes the formation of stuffy indoor environments (Figure 17). In new houses, there is no design approach such as changing the size and number of windows according to the features of the facades (opening less window spaces on the facades that do not receive sunlight and in the prevailing wind direction). The shading effect of the eaves is not sufficient in high-rise blocks (Figure 18).



Figure 17. PVC application that prevents natural ventilation in modern Talas residence [4].

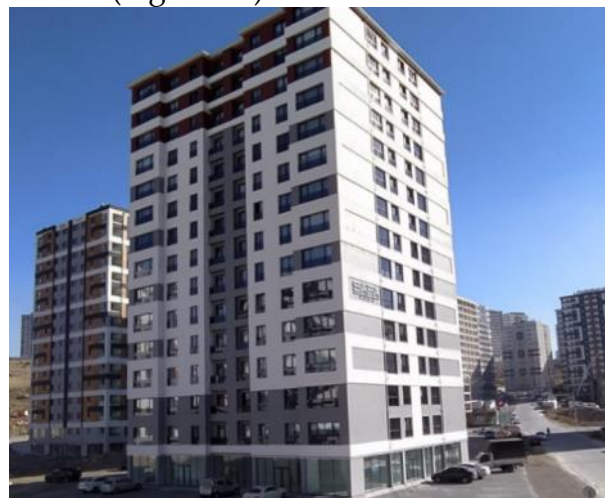


Figure 18. Ineffective eaves and application of window openings of similar dimensions on all facades [4].

5. Results

In the last century, due to disasters, migrations and developing technology experienced all over the world and in our country, houses that are insensitive to environmental data have been produced by moving away from traditional housing approaches. Housing designs, which have negligence not only in environmental data, but also in socio-economic and cultural terms, have created negative effects on the development of society [21]. In our study area; the street texture in the traditional Talas settlement has a naturally developed, rhythmic arrangement, limited by low-rise and adjacent houses, narrow enough for people and animals to pass through, but has a texture that is in harmony with nature (Figure 19).

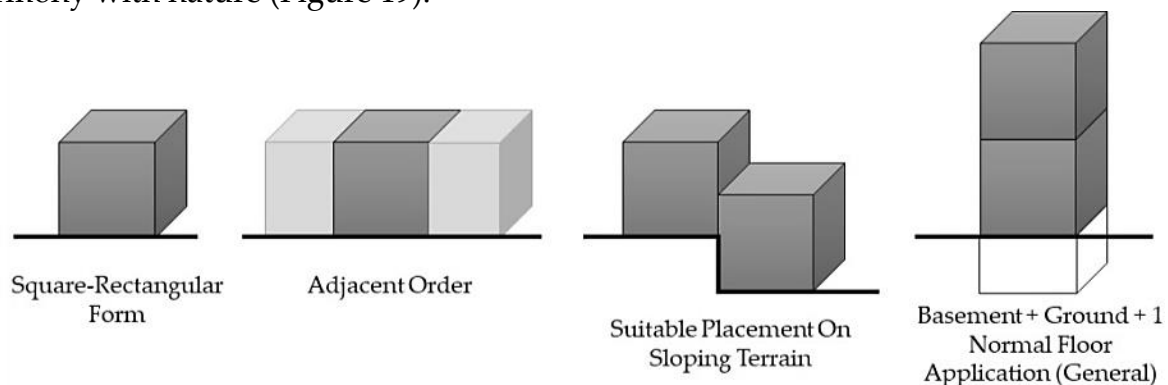


Figure 19. Traditional Housing Typology.

Today's street structure is shaped by the boundaries of high-rise and generally separated apartment blocks, detached from the ground, in the forms permitted by legal regulations, weakening people's relations with their surroundings (Figure 20-21). As in the traditional Talas houses, since more than one house is tried to be resolved on a plan plane in the apartment blocks where square and rectangular forms are preferred, climatic criteria are not considered in the spatial layout and the relationship of the houses with each other. (sunbathing, shading, etc.)

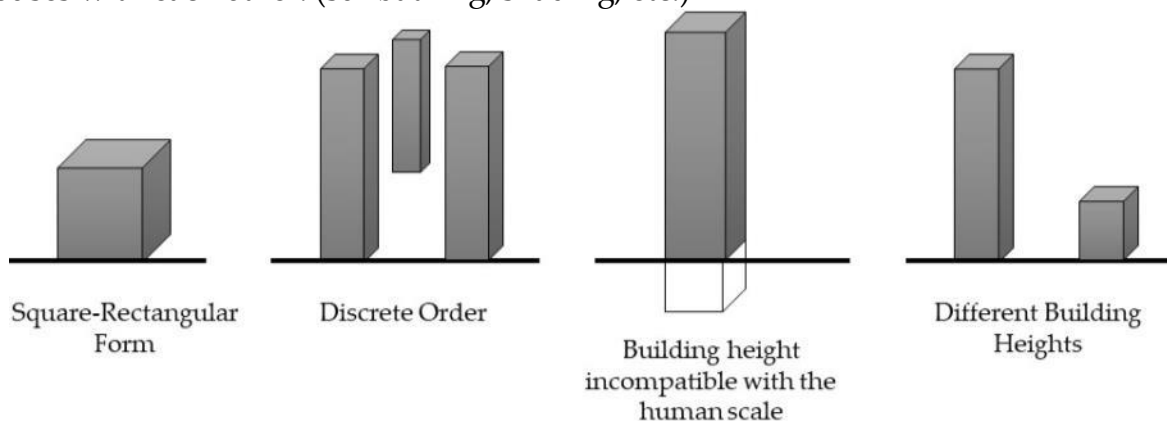


Figure 20. Modern Housing Typology.

Since openings of similar sizes are designed on each facade, additional systems were needed for hot-cold control. The application of solar control according to the location of the joinery applied in traditional residences does not have the desired effect because the wall thickness is small in new residences. On the streets where houses with different and disproportionate storey heights are located together, street silhouettes are formed that negatively affect the urban texture, and the wind effect is felt more strongly on the buildings since the street width-floor height relationship is not considered (Figure 22).



Figure 21. High-rise, square-rectangular apartment blocks detached from the floor and usually with discrete order[4].



Figure 22. Street texture where different floor heights coexist [4].

Although some precautions have been taken, such as the use of covers on windows to protect against outdoor conditions in traditional residences, there is no search for any solution despite the developing solution methods and increasing material options in today's structures. In addition, there are also disadvantages in terms of privacy in residential buildings that do not have the possibility of inward orientation, such as a courtyard, are located close and have similar facade openings. In traditional Talas residences, which were in harmony with the environment at the time they were built, passive systems and renewable energy sources were used for heating and cooling needs (such as wood and organic-based wastes for heating). As a requirement of natural ventilation, dwellings have been produced that breathe and provide ventilation in natural ways with the approach of having two windows in each space, the star windows on the window tops and the grooves designed between the floors. In addition, since the materials used in the construction of houses are natural and local, environmental pollution has not been caused in the production of any of the materials,

moreover, a local texture has been obtained. The stone material used on the façade provides thermal insulation due to its properties, and the wooden joinery used in the façade openings provides natural ventilation. However, most of the materials used today do not have these properties. Unhealthy materials that do not have a local texture, do not contribute to comfort conditions, can cause environmental pollution during the production process, are produced quickly but do not allow the house and the user to breathe, are used in the houses. Since the structures built with materials such as concrete and brick cannot provide natural thermal insulation, materials such as xps that do not breathe and the production process harms the environment were used. While fossil fuels are used for heating and mechanical systems are used for cooling, airtight PVC joinery is preferred for window openings. A roof compatible with the climatic conditions, consisting of a combination of wood, stone and soil materials, was preferred on the roofs of traditional Talas residences. In modern houses, generally hipped, gable roofs are used, regardless of the wind situation of the region. In traditional buildings, the water accumulated on the roof was transferred to the street with gargoyles made of stone material. While water is consciously used with elements such as water wells and cisterns in traditional houses, no measures are taken in terms of clean water or gray water in today's houses, despite the developing technologies (Such as luminaire selections or water collection systems). 16% of fresh water resources, which are our indispensable resource, are consumed in the process of construction activities and the use of the structure. It is possible to save water by 50% by increasing the number of ecological dwellings [6, 24]. Unlike traditional Talas residences, which have a garden behind each residence and can manage environmental conditions with landscaping elements (thanks to deciduous trees, there is sun in winter and shade in summer), residential buildings have appeared that are trying to meet the need for green space with concreted gardens and insufficient parks. As a result of all these inferences, the evaluation of traditional and contemporary houses in terms of design criteria, based on the design criteria in the study of Ünal (2014), is shown in Table 3.

Table 3. Evaluation of design criteria of traditional and modern residences.

	Purpose	Description	Traditional	Modern	Description
Location Selection	Slope and Orientation	South, South East direction	+	-	The correct slope in the construction (traditional)
	Topography	Adaptation to topography	+	-	Gradual structuring according to the slope (traditional)
	Sun And Wind	Maximum benefit from sun and wind	+	-	Solar and wind are taken into account (traditional)
	Relationship with the Environment	Compliance with human scale	+	-	High and disconnected from the human scale

(modern)					
Building Form and Shell	Energy Conservation	Suitable form	+	+	Square-rectangular form.
		Heat-sound insulation	+	-	Use of thick, stone walls (traditional) Heat loss measure with only sheathing (modern)
	Gaps Design	Gaps design for natural ventilation and lighting.	+	-	Star window and gutter arrangement (traditional)
	Adjacent Order	In terms of both land and energy saving.	+	-	Discrete order (modern)
	Planning the Space	Placement of spaces according to the functions in the house, planning of open spaces	+	-	It is placed in accordance with the functions and the use of the courtyard is available (traditional)
	Material Selection	The use of recycled and natural materials.	+	-	Use of local, natural materials and local texture (traditional)
	Protection Measures	Protection measure from environmental factors	+	-	Use of window covers (traditional)
	Privacy	Providing privacy for user comfort	+	-	The use of small windows at street level and the design of living areas on the upper floor (traditional)

Table 3(cont.). Evaluation of design criteria of traditional and modern residences.

Building Form and Shell	Production Speed	Short construction time.	-	+	Rapid but unqualified housing production (modern)
	Climate	Consideration of climate data in construction (arch.)	+	-	Climatic data is not taken into account (modern)
	Roof Type	Selection of roof type sensitive to environmental data	+ -	+ -	Considering the snow load, hipped roof application (mod.), storm etc. flat roof application suitable for events (traditional).
Water Reuse	Rainwater Recovery	Obtaining additional water source by collecting water	+	-	Drainage of rain water from the roof with gargoyles and water well applications (traditional)

Energy	Use of Low Consumption Plumbing	Tools such as faucets that use less water, waterless toilets.	-	-	Although there are opportunity today, standard installations are used.
	Energy Use	Effective Use of Energy	+	-	Renewable, natural resources (traditional), fossil fuels (modern) were used.
Landscape	Landscape Design	The use of plants that protect the existing cover and provide user comfort.	+	-	Use of plants that provide sun-shade-wind protection (traditional)
	Green Area	Availability of private-joint enough green space.	+	-	Each house has a private green area (traditional) There are limited communal green spaces (modern)
Transport	Transportation Design	Transport appealing to all users, proximity to public transport.	+	+	Developing transportation opportunities despite the increasing population.
Social Facilities	Presence of Social and Cultural Facilities	Social and cultural facilities are within walking distance	+	+	Traditional and today's residences are within walking distance of many social and cultural areas such as mosques and shopping.

All these comparisons show that designs that are closed to nature and traditional experiences bring problems that will create material, moral and psychological burden both in the production and use processes. When up-to-date building materials are used in line with traditional architectural principles in new designs, besides ensuring sustainability, healthy and comfortable spaces will be obtained at low costs.

6. Discussion and Conclusion

Such disasters as earthquakes, floods, fires that have occurred both in the world and in our country are a reminder that we should predict longer-term consequences, rather than design housing to withstand ordinary wear and tear [7]. However, it will be possible to save the houses designed with an architectural disaster point of view from future disasters [13]. In order for existing housing design approaches to withstand rapidly changing environmental forces, they need to go to the next level by getting out of their ordinary shells. This progress is possible with designs that can respond to both current conditions and extreme formations, as well as meeting the needs of form, function and aesthetics [5]. Achieving this goal will be possible thanks to sustainable and flexible designs made by blending the material science of architecture, technological developments, meteorological data and predictions. While making

sustainable, flexible and durable designs, it is necessary to make decisions specific to the area where the design will be made. Some of the residential design strategies that contribute to these decisions are outlined below:

Design: With the structure design that is flexible, adaptable to changing conditions, durable, has a long service life, and can respond economically to different needs with modularity, both indoor conditions should be protected and safe shelters for users should be created [20]. In addition, a mechanism that controls the quality and continuity of housing design should be developed.

Site Selection, Building Form and Shell: Choosing a location compatible with the topography and shaping the building envelope and building form in accordance with the physical environment data are effective factors in meeting the climatic comfort needs from natural resources in housing designs. In order to make sufficient use of the sun and wind factor and to be protected when necessary, to have privacy, to escape from noise, to open to the view and, accordingly, to minimize energy consumption and to prevent environmental pollution, it is necessary to place housing in the appropriate slope and directional location. Natural ventilation should be used with methods such as windows and chimney ventilation, taking into account air pollution, noise pollution and climatic features [19]. Daylight should be used as the primary lighting source, and light wells, light shelves, inner courtyards and atrium areas should be preferred to provide daylight in large interior spaces. In order to save water, measures such as low water consumption siphon systems should be taken, and waste generation and reuse policies should be developed.

Material: The use of environmentally friendly, recyclable materials that are not unfamiliar to the region's environmental data is a helpful element to achieve durability. It provides great advantages in the design and application phase, as there is usually no problem in the supply of local materials and transportation costs are lower. Also, materials such as wooden, bamboo must be preferred in order that construction chemicals do not affect human health negatively [25]. It will be possible to provide more resistance against disasters by evaluating some materials used in different areas in the architectural field, taking into account the material foresight. For example, the use of graphene as a reinforcement material for concrete [5].

Transportation: Transportation is among the sectors with high energy consumption. In order to meet this need, housing designs should be designed in an integrated manner with public transportation systems

Landscape: It is possible to manage the air conditioning in and around the building with landscape applications. In addition to the wind-directing, speed-increasing or cutting effect of plant communities and trees, shade and heat gain effects in terms of solar radiation should be considered (Figure 23).

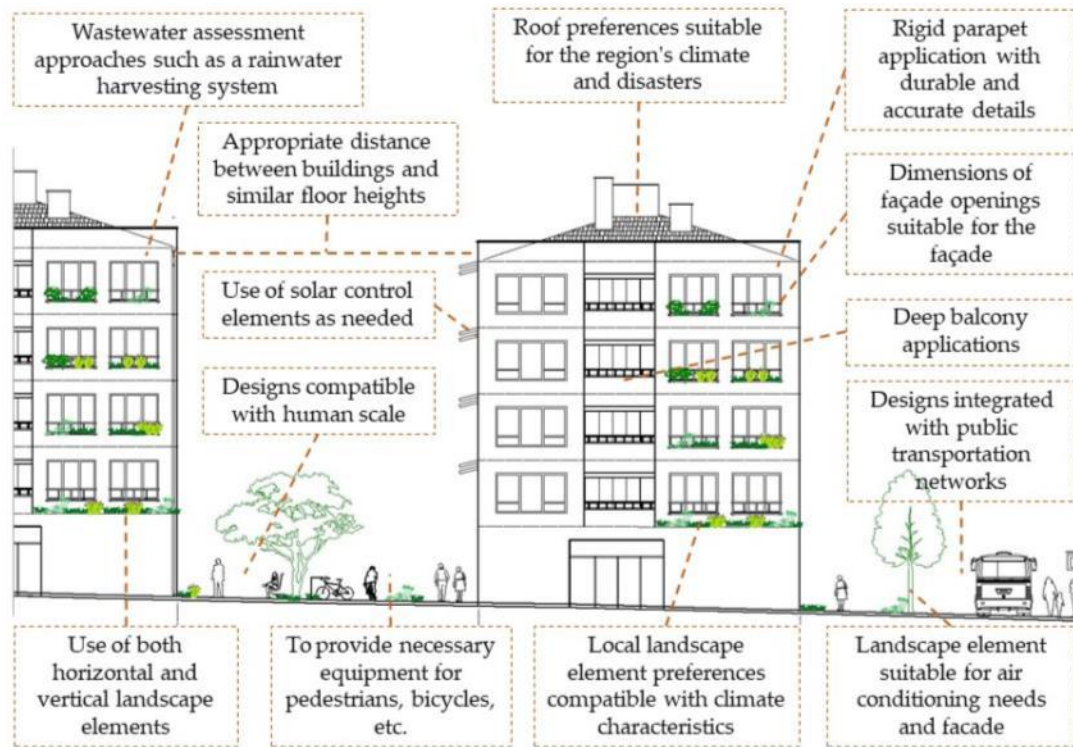


Figure 23. Housing design strategy recommendations.

In the light of all these criteria, the creation of houses and cities with high quality of life and resistant to climate changes and the disasters they trigger should be among the top priorities. Based on the comparison results we have made, taking sensitive steps that can extend to the future in all city planning, including the cornerstone of housing design, can only be achieved by examining all environmental and climatic data of the city. In this regard, a solution can be found both with the awareness of the user and producer parties, and with the support of foresighted legal regulations that are sensitive to changes to be made by official institutions. The public should be informed about the works and designs, and the housing design should be done by emphasizing the activities that increase the quality of life. The disasters and their damages should be recorded, and a structural design should be made in the affected area in the light of the previous disaster. Local governments should re-evaluate the regions with increased frequency of disasters and take region-specific measures in their zoning plans. Only in this way, living spaces that do not fight nature and are open to development can be created. Designing a durable structure means; it means starting the design process by thinking in detail about the typical usage scenarios of the building and possible disaster scenarios that may disrupt the design integrity with the environment.

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