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Research Paper

Determining Environmental Ethics Criteria in Residential Complexes (Case study: Rajia and Kasra Residential Complexes in Qazvin) [1]

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Abstract
In contemporary times, the imperative to address ethical considerations within the realm of architecture has escalated, primarily in response to the prevalent environmental challenges. Environmental ethics, a facet of applied ethics, delves into the intricate interplay between nature and the exigencies arising from indiscriminate human interventions in the environment. The present research employs a descriptive-analytical approach to discern indicators of environmental ethics methodologies, drawing insights from the Hannover Principles and pertinent case studies. Within the purview of this study, the qualitative content analysis method is employed to scrutinize the conceptual framework of these principles and their ramifications on residential complexes. To identify pivotal indicators and criteria catering to residential needs, the Expert questionnaire and AHP method are applied. The accrual of research data is facilitated through a researcher-developed questionnaire, subsequently subjected to analysis utilizing SPSS statistical software. The analytical approach involves correlation coefficient analysis and a one-sample t-test. In alignment with the Hannover Principles, environmental ethics indicators are systematically classified into three distinct categories: principles pertaining to human aspects, those linked to nature, and principles concerning productivity. This study aims to investigate the role of these principles as evaluative criteria in the design of contemporary residential complexes. The central research question guiding this inquiry is articulated as follows: To what extent have environmental ethics principles been integrated into the design paradigms of modern residential complexes? The empirical findings underscore the imperative of infusing environmental ethical standards into the fabric of sustainable building creation. Notably, principles related to human aspects emerge as particularly consequential, garnering the highest score among all the considered criteria for Residential Complexes.

Keywords: *Environmental ethics, Contemporary architecture, Residential complex, AHP method.*

1. INTRODUCTION

In recent years, the concept of sustainability has emerged as a central element in both political and social arenas, exerting a growing influence on practical considerations. Theorists focusing on sustainable development have advocated for the manifestation of social prosperity and active community participation. This perspective operates within a comprehensive framework that incorporates technical, physical, social, and economic factors (Khan Mohammadi, 2009). Within this multifaceted approach, a subset identifies three fundamental pathways: environmental, social, and economic. Each of these pathways contributes to elucidating the role of ethics in cultivating a harmonious relationship among these interconnected elements. Experts posit that

[1] The present article is derived from Ph.D. thesis entitled "Explanation of Architctual Ethics Philosophy and Its posture in Iranian Contemporary Architecture (Residential buildings and complexes from 1979 to 2019)" that is in progress at the Islamic Azad university of Qazvin under the guidance of Hossein Soltan Zadeh and advice of Hamed Mazaherian

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ethics serve as a communicative bridge, facilitating a process grounded in morality and guided by these interdependencies. Ethical communication encompasses principles of social justice, equality, and a respectful rapport with nature (Becker CU, 2012). Respecting nature is important in many religions and cultures, where nature is considered a sacred entity or a creature of God (Azizibabani et al., 2022, 1).

Ethics and conduct stand as fundamental pillars in the establishment of urban environments, representing crucial elements in the shaping of architectural structures. This viewpoint legitimizes human interactions with fellow inhabitants, the natural environment, and human-made creations (Naghizadeh, 2015:63-8). In contemporary discourse, addressing challenges stemming from the improper utilization of the environment finds a significant recommendation in the perspective of environmental ethics. According to environmental ethics, ethical frameworks should expand to encompass the intricate relationship between humans and the natural world (Robinson, Garat, 1999). In essence, environmental ethics offers a sound foundation for the alignment between overarching objectives, means, and the principles of development and sustainability (Abbaszadeh Tehrani, 2016).

The rationale behind the expansion of the concept of environmental ethics lies in the escalating trajectory of environmental degradation (Bourdrau, 2004: 9-15). Certain scholars argue that contemporary environmental crises are inherently moral and value-based, necessitating ethical resolutions. The erosion of human values, particularly moral values, is posited as a contributing factor to the exacerbation of environmental challenges (Fabinyi, 2011). Environmental ethics engages with elements such as values, beliefs, and attitudes, presenting itself as a set of principles aimed at formulating ethical solutions to global environmental concerns. These concerns encompass the intricate web of human-environment relationships, the comprehension of environmental responsibility, and a steadfast commitment to preserving resources for the well-being of future generations (Pojman, 2001).

The evolution of sustainable architecture necessitates a holistic approach to its development. Acknowledging this imperative has prompted the incorporation of an ethical perspective as an integral component of the overarching strategy for sustainable architecture. The central focus of the current research holds profound significance within the architectural community (Jenkins TN, 2003: 131-156).

Design driven by ethical considerations serves as a catalyst for both social and environmental sustainability, contributing to an improved quality of life in the present. In the contemporary context, the discourse on ethical values in architecture has become imperative, particularly in light of pressing environmental challenges. The pursuit of embedding ethics in architectural practice has encountered obstacles, often impeding the seamless integration of values into professional services. This study endeavors to examine the role of formal building components in upholding environmental ethics, with a specific focus on two residential complexes in Qazvin City serving as the research context. The primary objective of this research is to analyze the criteria of environmental ethics within the design framework of modern residential complexes, underscoring the critical interplay between these two variables.

2. RESEARCH BACKGROUND

The majority of studies in architecture have primarily focused on a general examination of ethical components, allocating comparatively less attention to the specific criteria for environmental ethics and its consequential impact on design. A consensus among scholars suggests that advocating for ethical solutions rooted in environmental ethics can establish a robust framework for a comprehensive approach in this realm. This article addresses the "need for adherence and a commitment to ethics in architecture" through a comparative analysis of ethical principles in ancient Iranian architecture and the professional ethics of architecture in other nations (Asadi, Saeedi, Beik Mohammadi, 2016: 69-7).

A study titled "Assessing the Significance of Iranian Ethics in the Traditional Architecture of Desert Cities" delved into the influence of ethical values throughout the stages of construction, from development to operation. This exploration has been approached through diverse perspectives, encompassing the preservation of endowment culture, compliance with chivalry letter guidelines, and a dedicated emphasis on principles such as unity, humanity, and fostering a symbiotic relationship with nature (Pourmand, Bamanian, Mehdinejad, Samadzadeh 2015:59-8).

Moreover, the work titled "The Correlation Between Ethics and Technology in Islamic Society Architecture" aimed to elucidate the relationship between ethics and architectural technology, delineating the crucial elements of ethics within Islamic society architecture (Ebrahimi Nejad, Farshchian, 2014). In a parallel vein, the article titled "Ethics in Architecture" conducted a comparative analysis of contemporary and traditional architecture education, exploring its influence on ethical principles. The article advocated for the emulation of

traditional architecture as a means to instill regulations governing the professional ethics of architecture (Nazi Dizaji, Vafamehr, Keshtkar 2010:105-114).

Within the historical context, the article titled "Ethical Insight in Contemporary Architecture: The Question of Tradition" underscored the dichotomy between alteration and continuity, attributing a moral obligation to the visual architecture (Moeini Fard, 2012: 25 -34). The examination of these studies reveals a significant gap in the comprehension of environmental ethics within the domain of architectural design. Despite its pivotal role in influencing sustainable architecture, there is a conspicuous absence of extensive research in this area.

The primary objective of this paper is to determine the degree of emphasis placed on environmental ethics criteria in the conceptualization and implementation of residential complex design. The central question guiding this inquiry is: To what extent have environmental ethics principles been taken into account in the design of contemporary residential complexes?

3. RESEARCH METHODOLOGY

This study employs a descriptive-analytical research approach. The process of data collection involved an examination of library documents and records, conducting field studies, and the distribution of questionnaires. Subsequently, the collected data underwent scrutiny to identify the criteria and sub-criteria of environmental ethics. Expert consultations played a crucial role in this analysis, and the Analytic Hierarchy Process (AHP) model, implemented through Expert Choice software, was utilized to systematically assess the gathered information.

Subsequently, an initial questionnaire was formulated, aligning with the prioritization of identified criteria and sub-criteria. Through expert consultations, the questionnaire items were refined to a total of 36. The reliability and normal distribution of data were assessed through the Cronbach-Alpha test and the Kolmogorov-Smirnov test, respectively. The research variables demonstrated a Cronbach-Alpha value of 0.7, surpassing the standard threshold and confirming the questionnaire's reliability. To enhance the study's validity, feedback was sought from two domain experts. The questionnaire, structured on a 5-point Likert scale encompassing categories such as low, average, high, very high, and no information, was administered to the entire population residing in Rajia and Kasra residential complexes in Qazvin, Iran. Employing Cochran's formula, a sample size of 315 residents was randomly selected as the study sample.

The questionnaire was structured around nine core components, namely:

Symbiosis with nature (questions 1-9)
Energy flow (questions 9-12)
Nature as a model (questions 12-19)
Value creation (questions 19-23)
Understanding continuity (questions 23-25)
Rubbish elimination (questions 25-27)
Knowledge sharing (questions 27-30)
Quality of life (questions 30-33)
Responsibility (questions 33-36)

The analysis of data was conducted using IBM SPSS software, utilizing both descriptive and inferential statistical methods to elucidate the study's findings.

4. THEORETICAL

4.1. Theoretical aspects of the research

4.1.1. Environmental ethics

The genesis of support for environmental ethics can be traced back to the 1960s, coinciding with the growing advocacy of the environmental movement (Kortenkamp, Moore, 2001: 261-272). Positioned as a branch of applied philosophy, environmental ethics holds a central position within the realm of bioethics (Minteer, Corley, 2003). Its objective is to navigate through a complex interplay of empirical data, philosophies, and human values, assuming the role of an adjudicator. Tasked with the formulation of comprehensive and coherent rationales, environmental ethics addresses the imperative of establishing ethical connections between humans and the surrounding natural environment (Kortenkamp, Moore, 2001: 261-272). Moreover, this field delves into the dichotomy of right and wrong conduct within a specified environment, offering a meticulous exploration of ethical behavior in an environmental context (Hatcher, 2004: 357-363). Despite possessing sophisticated regulations, environmentally friendly technologies, and intricate research endeavors, the path to long-term sustainable development remains obstructed without a robust foundation of environmental ethics (Abedi Sarvestani, Shah Vali, 2008: 6-56). In contrast to sustainable development, environmental ethics lacks a uniform and unequivocal definition. Broadly conceptualized, "environmental ethics" serves as a behavioral code, advocating adherence during production, consumption, and various facets of life. This guidance aims to cultivate a lifestyle that minimizes environmental harm and waste without compromising essential aspects of existence (Partovi, 2010: 123-133).

4.1.2. Sustainable Development

Sustainable development, often synonymous with sustainable building or sustainable architecture, encompasses construction activities and the created physical environment. The construction sector represents a formidable economic and social influence, transforming natural landscapes into built environments. Both the building sector and the broader built environment are acknowledged as crucial focal points in the worldwide quest for sustainable development (CIB, 1999: 237). Fundamentally, sustainable development entails fulfilling the needs of the current population while ensuring that future generations can meet their own needs, thereby avoiding detrimental impacts on future resources (Sadeghian et al., 2021:1).

In contrast to other manufactured artifacts, buildings exhibit a significantly extended lifespan and possess the capacity to contribute to sustainable development across multiple stages, encompassing design, construction, outfitting, demolition, and potential reuse. A building constitutes a synergistic amalgamation of materials, substances, and compounds, fostering intricate interactions. Beyond its structural components, a building profoundly impacts human health, as evidenced by data indicating that Europeans spend approximately 90% of their lives within architectural spaces (WGSC, 2004).

In contemporary discourse, social studies have intensified their attention on the escalating environmental crisis, a trend mirrored in the field of architecture and mirrored in other art forms. This evolution is rooted in the dynamic interplay between the fundamental principles of architectural design and thematic considerations of ecology, natural crises, and sustainability (Bani Massoud, 2006) (Figure 1). Consequently, architects assume a pivotal responsibility in leading initiatives towards sustainable solutions. Economies that demonstrate stability and growth must urgently and collectively confront environmental degradation, an urgent initiative aimed at mitigating the repercussions of past unsustainable practices before reaching a point where remediation becomes impractical.

4.1.3. Defining the Sustainable Architecture

The definition of sustainable architecture or sustainable architectural design is inherently intricate. According to Marchand and colleagues, sustainable design involves "a holistic reassessment of how objects are conceptualized, developed, manufactured, distributed, utilized, reused, recycled, and ultimately disposed of" (Marchand et al., 2006). They go on to emphasize that entities designed with sustainability in mind contribute to broader socio-cultural impacts, fostering new paradigms of living. Musacchio identified six foundational pillars for environmental sustainability—environment, aesthetics, ethics, equity, experience, and economy (Musacchio, 2009). Insights from the realms of architectural design and landscape management suggest that the ethos of sustainability extends beyond mere resource utilization and energy conservation, encompassing a broader sphere of influence grounded in the principles of sustainability.

These guiding principles are multifaceted, encompassing the pursuit of both tangible and intangible well-being, a dedication to equitable practices for present and future generations, the promotion of justice within and between societies, the safeguarding and nurturing of cultural and biological diversity, a cautious approach in decision-making, and recognition of the intrinsic interconnectedness of various phenomena (Throsby, 2001). The framework for architectural sustainability is crafted in the initial stages of project development, initiated with a conceptual vision, and sustained throughout the entire life cycle of the building. This commitment extends across design, site readiness, construction phases, and even factors into potential demolition or refurbishment endeavors.

A sustainable building is defined not only by its attributes of longevity, durability, and eco-friendliness but also by its contextual harmony, aesthetic appeal, and psychological nurturing. It aspires to contribute to the broader sustainable development of both the environment and society, embodying stewardship that includes resource and energy conservation and promotes social cohesion. In doing so, it enhances the quality of life on a more comprehensive scale (Kamičaitytė-Virbašienė et al., 2011: 35, 82–91).

Consequently, sustainable architecture grapples with the ambitious objective of devising comprehensive solutions that align with environmental requirements while simultaneously seeking to enhance the quality of life and uphold cultural, economic, and social values, along with considerations for comfort (WGSC, 2004). Achieving harmony between human habitats and sustainability goes beyond technological adaptations; it necessitates a transformation in human perception of the environment. This calls for fostering a deep-seated ethical regard for nature, a perspective echoed by numerous experts who view environmental resolutions as inherently ethical endeavors. This conviction underscores the imperative need to integrate environmental ethics standards in the blueprint of sustainable architectural projects, paving the way for a responsible and visionary approach.

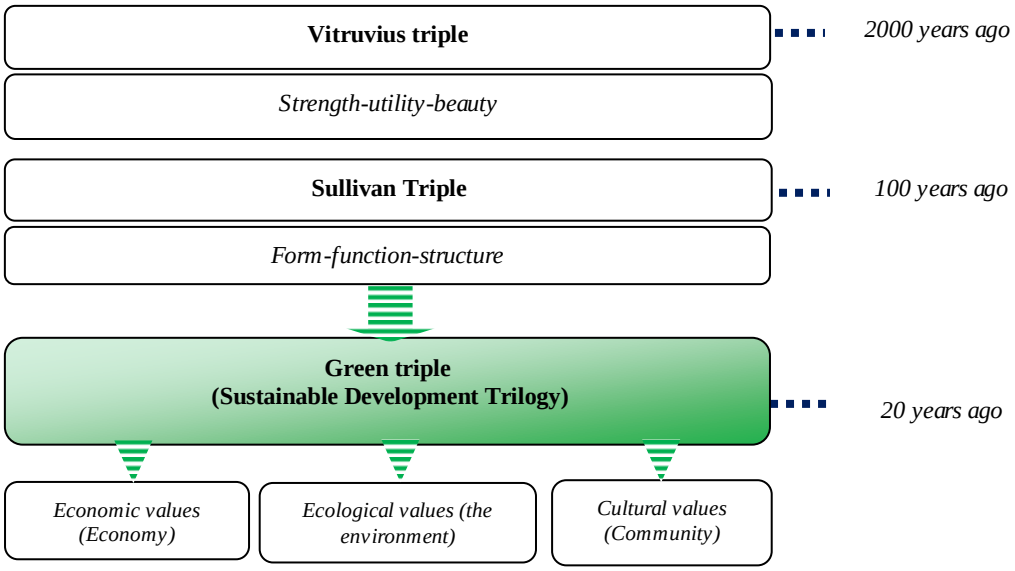


Fig 1. Three paradigms of architectural design (Source: Authors)

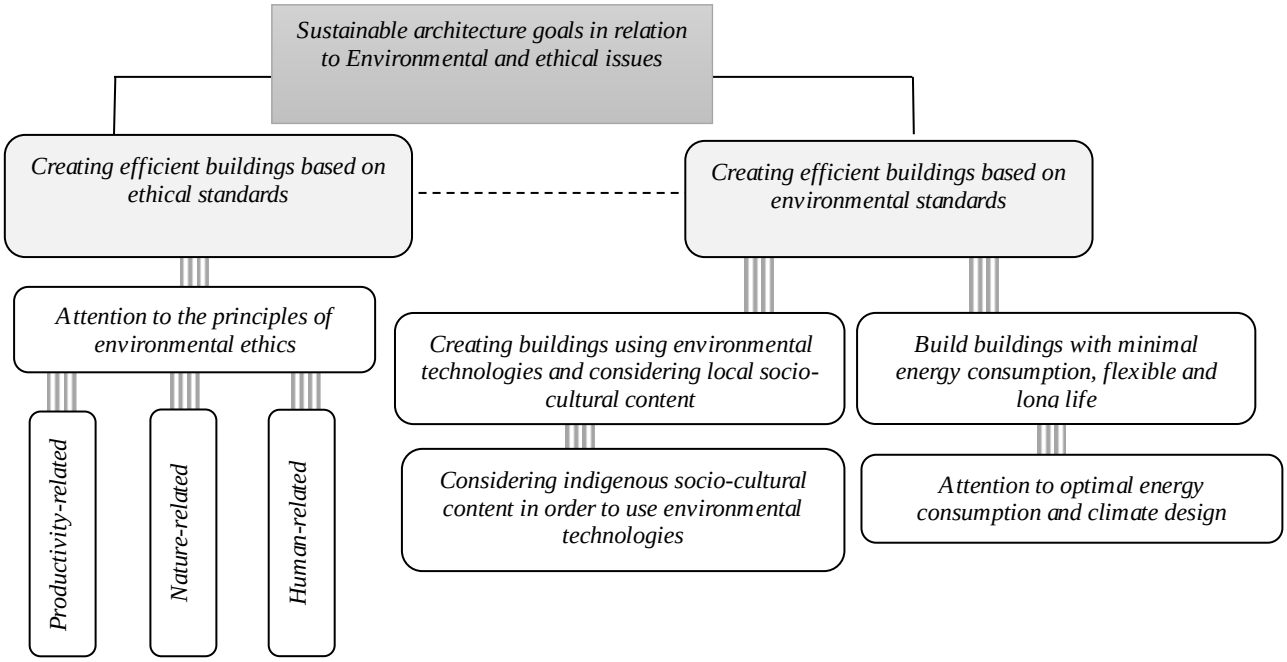


Fig 2. Sustainable architecture goals in relation to environmental and ethical issues (Source: Authors)

4.1.4. Explaining the criterion of environmental ethics in sustainable design

In general, diverse perceptions exist regarding "sustainable architecture." Nonetheless, there is a consensus that this architectural approach places significant emphasis on constructing the built environment while prioritizing the conservation of natural resources for the benefit of future generations (Flamki, 2005).

Sustainability requires a holistic approach to its ongoing evolution. According to theorists in sustainable architecture (Azarbayjani et al., 2003), integrating an ethical perspective into sustainability presents a viable solution. Environmental ethics, emerging in response to contemporary challenges, provides a robust foundation for cultivating ethics in sustainability (Abbasi et al., 2015). This branch of philosophical ethics imposes a moral obligation on humans to coexist within nature's limits and prioritize the reduction of environmental footprints in designs (Douglass et al., 2016). In 1996, William McDonough and others proposed a significant research initiative to establish ethical criteria for sustainable design, subsequently published under the title "The Hanover Principles" (McDonough, 1998). These principles, centered on people, environment, profit, and sustainable productivity, are outlined as follows:

1. Insist on the rights of humanity and nature to coexist in a healthy, supportive, diverse, and sustainable condition.

2. Recognize interdependence. The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations to recognize even distant effects.

3. Respect relationships between spirit and matter, emphasizing the quality of life. Consider all facets of human settlement, encompassing community, dwelling, industry, and trade, with regard to the existing and evolving connections between spiritual and material consciousness.

4. Accept responsibility for the consequences of design decisions on human well-being, the viability of natural systems, and their right to coexist.

5. Create safe objects of long-term value. (Create value) Do not burden future generations with the requirements for maintenance or vigilant oversight of potential danger arising from the careless creation of products, processes, or standards.

6. Eliminate the concept of waste. Evaluate and optimize the full life-cycle of products and processes to approach the state of natural systems where there is no waste.

7. Rely on natural energy flows. Like the living world, Human designs should derive their creative forces from perpetual solar income, utilizing this energy efficiently and safely.

8. Acknowledge the limitations of design, modeling nature. Recognize that no human creation lasts forever, and design cannot solve all problems. Those involved in creation and planning should practice humility in the face of nature, treating it as a model and mentor rather than an inconvenience to be evaded or controlled.

9. Seek constant improvement through the sharing of knowledge. Encourage direct and open communication between colleagues, patrons, manufacturers, and users to connect long-term sustainable considerations with ethical responsibility, thereby re-establishing the integral relationship between natural processes and human activity. Consider the Hannover Principles as a living document dedicated to facilitating growth and understanding of our interdependence with nature, adaptable as our knowledge of the world evolves.

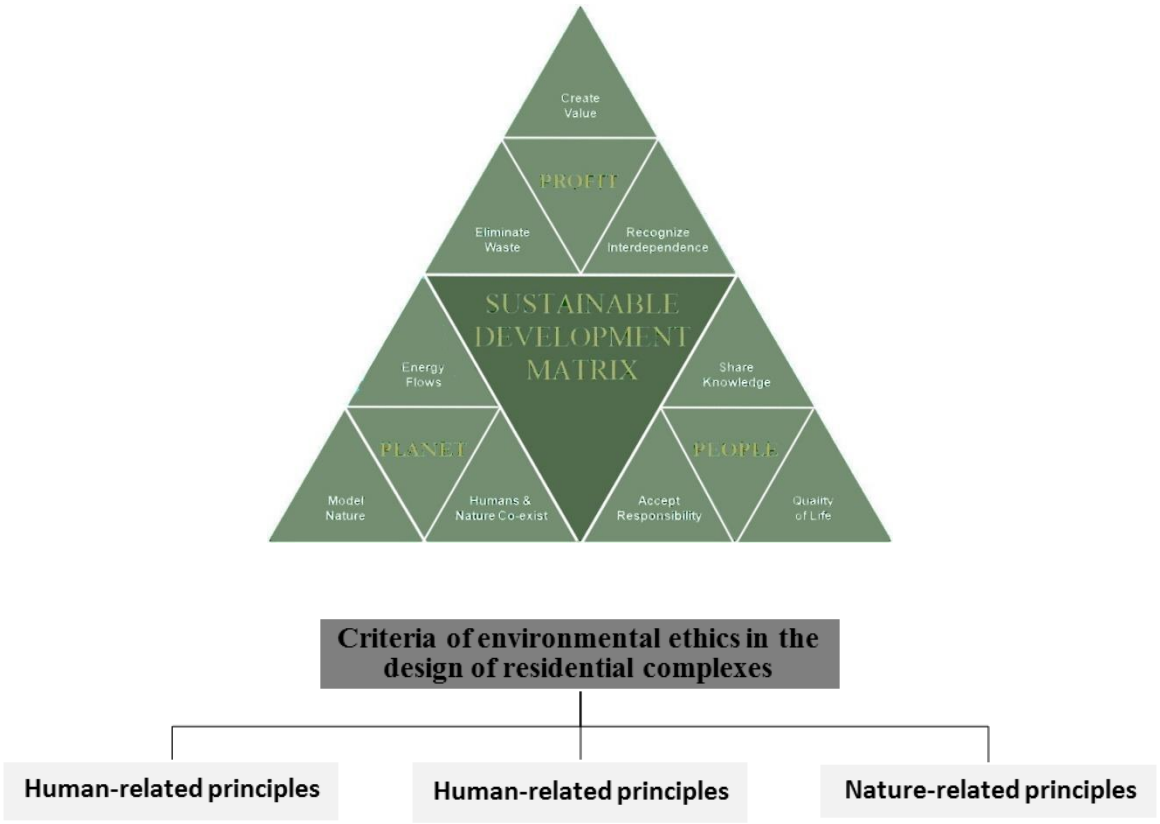


Fig 3. Sustainable development matrix (McDonough, 1998)

4.2. Findings of the research

The model employed in the present study to assess environmental ethics criteria in architecture is the Analytic Hierarchy Process (AHP). This model facilitated the exploration of environmental ethics through three categories: nature-related principles, human-related principles, and productivity-related principles. The criteria for environmental ethics in architecture are organized into three main sections and nine sub-criteria, providing a framework to evaluate the extent to which architectural designs adhere to ethical considerations. These elements are illustrated in Figure 4, presented in the form of a hierarchical diagram. The selection of criteria was based on considerations such as scientific validity, data and information accessibility, and the feasibility of conducting studies in residential complexes.

4.2.1. Determining the criteria and sub-criteria of environmental ethics in residential complexes

In the hierarchical analysis process, a range of criteria and sub-criteria were identified to comprehensively address the diverse aspects of principles related to observing environmental ethics in architecture. These criteria have been systematically organized based on shared sub-criteria. The assessment of the influence of these sub-criteria on upholding ethical considerations during planning was conducted through consultation with reputable sources in the field, including The Hanover Principles, and by referencing findings from internationally recognized researchers specializing in residential complexes.

4.2.2. Determining the preference coefficient of the criteria

During this phase, the key criteria underwent a binary weighing process. The significance of each criterion was established according to its contribution to fostering ethical sustainability within residential complexes. The scoring intervals employed for the criteria were aligned with Saaty's 9-point scale, serving as the foundational framework for assessment. Employing the aforementioned weighting approach, which received endorsement from experts, the ultimate score for each criterion was determined using Expert Choice software. As depicted in the diagram, a low inconsistency coefficient of 0.01 confirmed the consistency in the assigned scores, affirming the reliability of the model's outcomes.

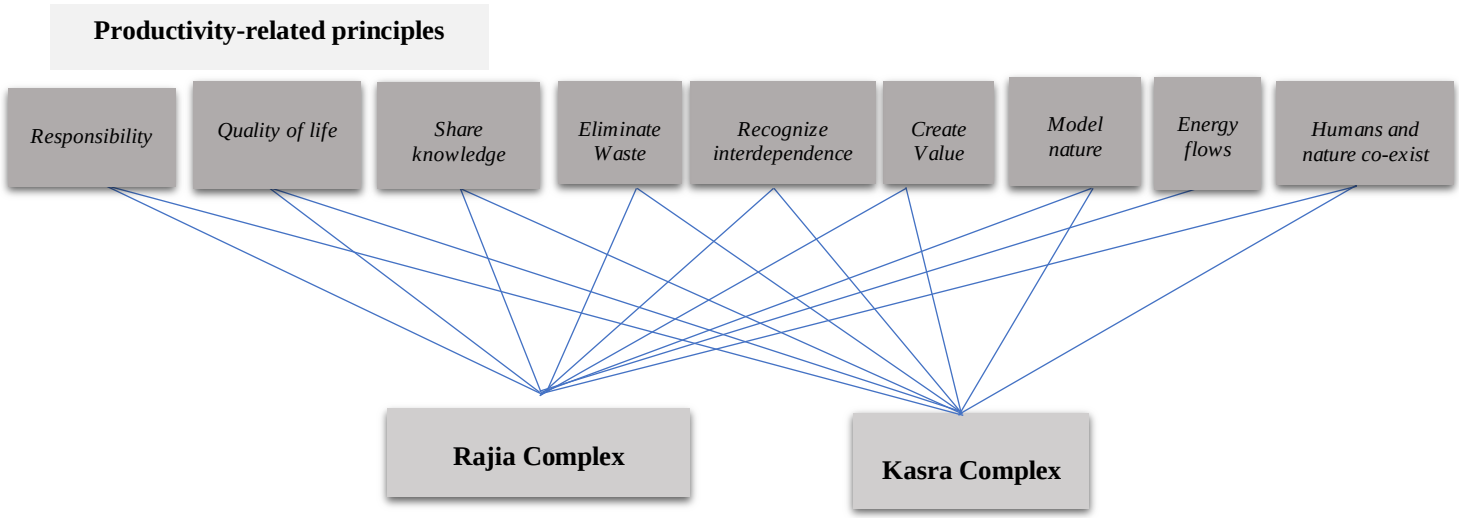


Fig 4. Hierarchical model according to the criteria and sub-criteria set in the research (Source: Authors)

Table 1. Parallel comparison of criteria. (Source: Authors)

	Nature-related principles (C1)	Human-related principles (C2)	Productivity-related principles (C3)
Nature-related principles (C1)		.923	1.719
Human-related principles (C2)			2.69
Productivity-related principles (C3)			

A methodical pairwise comparison of both criteria and the ensuing sub-criteria was undertaken to establish the weight of each individual factor. Table 1 illustrates the pairwise comparison of the principal criteria, where the values presented indicate the relative importance of the criteria in the horizontal row compared to those in the vertical row. A panel of 10 experts, guided by the values outlined in Table 1 and Saaty's 9-point scale, determined these values. The conclusions were subsequently consolidated using the geometric average method.

The model was illustrated in Expert Choice software to derive the weights from the pairwise matrix featured in Table 2, wherein the pairwise comparisons were input. Figure 5 displays the final assessments of the primary criteria. The data illustrates that the foremost three ranks pertain to human-related principles (C2), nature-related principles (C1), and productivity-related principles (C2), holding respective weights of 0.447, 0.365, and 0.188.

4.2.3. Determining the importance coefficient of the sub-criteria and analyzing the criteria for designing residential complexes

Similarly, pairwise comparisons were undertaken for the sub-criteria. These were subsequently input into the Expert Choice software, with the results delineated in Table 2. The relative weight was derived from the pairwise comparison of the sub-criteria within their set. The final weight assigned to each sub-criterion was computed by multiplying it with the main criterion weight. Consequently, the top three ranks are attributed to the principles of "humans and nature co-existing" (C11), "creating value" (C21), and "eliminating waste" (C23), holding respective weights of 0.193, 0.159, and 0.149.

4.2.4. The method of selecting case studies

In the final phase of the analysis, the criteria of environmental ethics in the architectural design of residential complexes underwent scrutiny through the examination of two case studies, complemented by a questionnaire survey. Residential complex designs can be broadly categorized into three types: linear patterns, scattered patterns, and central patterns (Einifar et al., 2010: 35-45). In the city of Qazvin, residential complexes are primarily constructed using either linear or scattered patterns. Aligning with the research objectives, two residential complexes in District 3 were selected as samples from a pool of 37 complexes in Qazvin city. These include 1) The Rajia residential complex with a linear pattern, and 2) The Kasra residential complex with a scattered design pattern, as introduced in Table 3. Geographically, they share a common municipal location, illustrated in Figure 6, and maintain a comparable pricing structure. Additionally, a survey affirmed a similarity in the economic and social standings of the residents residing in these complexes.

Fig 5. Relative weight of criteria (Source: Authors)

Table 3. Introduction of case studies (Source: Authors)

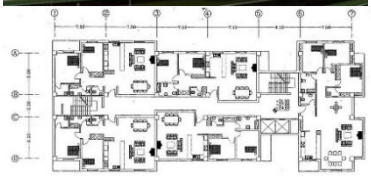
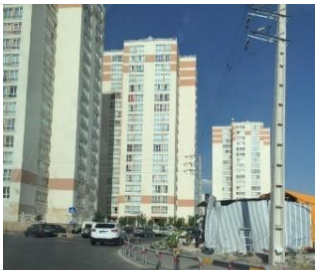
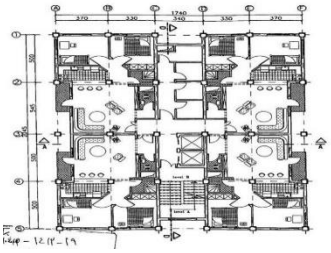
Complex	Site location	Complex images	Typology	characteristics	
Rajia Residential Complex 2017		 	(Linear structure)(Scattered structure)	Land area	9001 m^2
				Area	3000 m^2
				Number of blocks	14
				1. Physical Structure Pattern	Linear pattern
				Number of units	221
Kasra Residential Complex 2016		 		Land area	1000 m^2
				Area	6000 m^2
				Number of blocks	17
				2. Physical Structure Pattern	Scattered patterns
				Number of units	816

Fig 6. The location of the complexes relative to each other in the city (Source: Authors)

The findings from the data analysis, as presented in Table 4, reveal that in the Kasra residential complex, the components with the highest average values under the "Coexistence with Nature" index include "thermal comfort system design and audit," "preventing the creation of heat islands through non-roofing strategies," and "water-saving in irrigation systems." Similarly, in the Rajia residential complex, the components with the highest average values under the same index are "preventing the creation of heat islands through non-roofing strategies," "preventing ozone depletion through the use of specific cooling equipment," and "water-saving in irrigation systems."

Furthermore, the data indicates that in the energy index of the Kasra residential complex, the component "use of renewable energy sources" achieved the highest average level among the relevant components. Similarly, in the Rajia residential complex, the "use of renewable energy sources" component obtained the highest average value in the energy category.

Furthermore, in relation to the principles associated with the ultimate indicator, "nature of the last indicator," the component "measuring and auditing of energy consumption in the building" exhibited the highest average value in both the Kasra and Rajia residential complexes.

As per the principles associated with productivity, the outcomes for the Kasra residential complex have indicated that the component "use of materials and local products and vernacular materials" within the continuity perception index holds the highest average. Furthermore, the component "storage and collection of recyclable materials" in the waste disposal index and the component "to ensure the accurate performance of energy systems in buildings" in the value creation index exhibit comparable averages, respectively.

In the Raja residential complex, the results show a slight divergence. In this context, the component "to ensure the accurate performance of energy systems in buildings" within the value creation index and the component "storage and collection of recyclable materials" in the waste disposal index obtain the highest averages. Additionally, the component "use of materials and local products and vernacular materials" in the continuity perception index maintains a comparable average.

Table 4. The average of effective components on research indicators (Source: Authors)

Variables	Indicators	Components	Kasra Average	Rajia average
Nature-related principles	Humans and nature co-exist	Provide sufficient access to transportation systems.	2.69	2.48
		Optimize energy performance	2.42	2.57
		Minimum energy performance	2.65	2.57
		Achieving the minimum preferred indoor air quality	3.02	2.92
		Control of chemical and biological pollutants and dangerous particles in indoor spaces of buildings	3.15	2.72
		Thermal comfort system design and audit of the thermal comfort system	3.36	3.19
		Provision of natural light	2.61	2.81
		Provide a suitable perspective.	3.02	2.48
		The use of low-polluting materials, adhesives, sealants, paints and coatings, flooring, wood products	3	3.08
		Prevent the creation of heat islands in the non-roofing	3.08	3.69
		Water-Saving on the Irrigation systems	3.07	3.21
		Recycling using creative technologies	2,98	2.81
		Prevent the depletion of the ozone layer through cooling equipment	2.92	3.34
	Energy flows	The use of renewable energy sources	2.69	2.49
	Model nature	Measuring and auditing energy consumption in the building	2.46	2.92
productivity-related principles	Create Value	Ensure the accurate performance of energy systems in buildings.	2.54	3.38
	Recognize interdependence	The use of materials and local products and vernacular materials	3.27	2.27
	Eliminate Waste	Storage and collection of recyclable materials	2.98	2.81
Human-related principles	Share knowledge	Installation of existing carbon dioxide measurement systems in the exhaust air of the building and innovation in design	3.07	3.23
	Quality of life	Supply proper perspective and maximize open space	2.84	3.42
	Responsibility	Prevent the depletion of the ozone layer through cooling equipment	2.54	2.69

In the examination of the principles related to humanity, the final dimension outlined in the questionnaire, it is evident that within the Kasra residential complex, the components "installation of existing carbon dioxide measurement systems in the exhaust air of the building and innovation in design" in the knowledge-sharing index exhibit the highest average. Likewise, high averages were noted for the components "supplying a proper perspective and maximizing open space" in the quality of life index and the component "preventing the depletion of the ozone layer through cooling equipment" in the responsibility index.

The results in the Rajia residential complex align similarly, with the components "supplying a proper perspective and maximizing open space" in the quality-of-life index and the components "installation of existing carbon dioxide measurement systems in the exhaust air of the building and innovation in design" in the knowledge-sharing index attaining the highest averages. Furthermore, the component "preventing ozone layer depletion through cooling equipment" in the responsibility index achieved a matching high average.

The findings indicate a notable correlation in both residential complexes when subjecting elements like coexistence with nature, energy, nature as a pattern, value creation, continuity perception, waste disposal, knowledge sharing, quality of life, and the responsibility index to the coefficient test. These results are detailed in Table 5, demonstrating that all significance coefficient indexes are below 0.05, signifying a harmonious alignment with principles related to nature.

Upon scrutinizing the questionnaires completed by the residents of the two complexes, it was discerned that the Kasra residential complex closely aligns with the perspectives of experts, particularly concerning human-related principles. These principles encompass knowledge-sharing criteria, principles related to nature, the design of heating systems, the audit component, and regulations aimed at understanding coherence efficiency, all of which garnered the highest scores.

Conversely, within the Rajia residential complex, the greatest emphasis was placed on different elements within the human-related principles. The highest scores were allocated to the quality of life component under principles referring to nature, strategies for preventing the creation of heat islands in the non-roofed areas, and productivity-related principles fostering value creation.

Table 5. Correlation coefficient of research indicators (Source: Authors)

Dimensions	Indicators	complex	Average	Standard deviation	Value amount	Significance level	Release Degree
Nature-related principles	Humans and nature co-exist	Kasra	2.92	0.863	15.769	0.000	119
		Rajia	2.91	0.568			
	Energy flows	Kasra	2.69	0.642	10.104	0.000	119
		Rajia	2.49	0.542			
	Model nature	Kasra	2.46	0.512	9.258	0.000	119
		Rajia	2.92	0.574			
productivity-related principles	Create Value	Kasra	2.54	0.685	3.664	0.000	119
		Rajia	3.38	0.610			
	Recognize interdependence	Kasra	3.27	0.611	5.941	0.000	119
		Rajia	2.27	0.683			
	Eliminate Waste	Kasra	2.98	0.718	8.240	0.000	119
		Rajia	2.81	0.585			
Human-related principles	Share knowledge	Kasra	3.07	0.534	15.827	0.000	119
		Rajia	3.23	0.585			
	Quality of life	Kasra	2.84	0.722	3.920	0.000	119
		Rajia	3.42	0.858			
	Responsibility	Kasra	2.54	0.504	9.250	0.000	119
		Rajia	2.69	0.677			

CONCLUSION

The findings of the present study underscore that the incorporation of environmental ethics principles is intricately linked to the design of residential complexes. These principles wield substantial influence over site design, shaping the quality and appeal of residential projects.

Professionals emphasize that various factors, such as coexistence with nature, knowledge-sharing, and responsibility, form a robust foundation for constructing residential environments aligned with environmental ethics principles. Particularly noteworthy is the prominence of human-related principles, identified as the most significant factors in environmental ethics, garnering the highest score among all criteria analyzed in the study.

Certain researchers contend that a commitment to humanitarian principles alone is inadequate for cultivating a genuinely ethical approach to environmental stewardship. They posit the necessity of incorporating two additional elements: regulations concerning nature and principles centered on efficiency.

Attaining human comfort in living spaces requires the fulfillment of material needs, a objective that cannot be achieved without harmonizing with nature and taking into account the essential living conditions for humans. A crucial aspect of this approach involves harnessing nature's inherent characteristics through the utilization of natural-based, eco-friendly, and climate-friendly materials.

Natural organisms demonstrate a remarkable adaptability to their surroundings, a characteristic that should inspire the evolution of human habitats. Beyond technological advancements, the establishment of a sustainable living environment necessitates a shift in human perception of the environment, broadening ethical considerations to encompass nature. Many experts view environmental challenges as fundamentally ethical issues requiring urgent resolution. Consequently, the incorporation of environmental and ethical standards is imperative in the design of sustainable buildings.

Despite the pivotal role played by environmental ethics criteria in the design of residential complexes, this domain remains relatively underexplored in research. Addressing this gap can contribute to a more profound understanding, laying the groundwork for both theoretical and empirical advancements in this field. Future studies should expand upon this research, possibly incorporating case studies from diverse cities to broaden the applicability of these findings. Acknowledging the crucial factors influencing environmental ethics criteria, as highlighted in this study, is highly recommended.

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