

Identification of the architectural ecology indicators in designing residential complexes based on visual quality enhancement

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ABSTRACT

Visual quality is one of the important quality aspects of the environments, especially in residential spaces. In the contemporary era, it is not cost-effective to allocate a space to yard for the modern materialist human beings considering the high material value of the land. Therefore, the proper conditions can be brought about for growing various plants in the spaces of the houses' roofs or terraces or on the exterior walls' surfaces and, besides creating beautiful landscapes, an appropriate solution can be consequently devised for cost-effectiveness in energy consumption. Based thereon, the present study deals with the designing of the residential complexes with the goal of enhancing the visual quality and an emphasis on the architectural ecology. The present study is an applied research and use will be made of a combined research method. Thus, efforts will be made to firstly recognize the various architectural ecology factors and their effects on the visual quality from the perspective of the various theoreticians so as to form the theoretical foundations of this research; then, the investigation of these factors amongst the inhabitants of the residential complexes enables the recognition of the most important and most influential of them. Considering the important factors that have been opined as the factors of visual comfort as well as the individuals' psychological and mental tranquility factors, it was found out that the architectural ecology indicators and the visual quality are mutually interacting and interrelated.

Keywords: visual quality, housing, nature, ecology, green roof

Introduction

Nowadays, the human beings are gradually distancing away from the natural environment in the course of the cities' formation and completion. Besides its apparent context, housing also has a real and spiritual context and it is designed and built based on the human beings material and spiritual needs. Buildings have

a context and their soul manifests the society's soul and culture and ideology. Resultantly, in order to create a proper dwelling space, paying attention to the nature and its elements in the designing of the houses causes the emergence of semantic visages therein. The housing's constructive spaces attain coordination and semantic and formative balance through taking advantage of the natural elements; moreover, besides creation of the psychological equilibrium and human tranquility, the ground can be also accordingly set for the creation of spiritual balance in the human beings (Mo'eni, 2012).

Visual comfort is amongst the important and essential indicators of the safe manmade environments because a city is a large house for living and residence and, in the same way that the house should feature certain traits and advantages so that the living and residence can be favorable and tranquilizing, the city should be also in possession of qualities and properties in line with the supply of comfort, peace and security; like a house, a city should be a cozy and sincere and pleasant environment so that it can provide the possibility of favorable life (Lynch, 1993, p.17).

The necessity about the visual quality in the cities is due to the absence of proper visual knowledge as well as the intensive effects that modernism functionalism has exerted on the cities and the visual confusion and abnormality it has imposed on the artificial human environment. Unlike the past periods wherein the attentions were carefully paid to this aspect of the spaces alongside the other intended dimensions and caused them to be recounted as high quality urban spaces, the today's negligence of this aspect of designing has caused visual problems to hold a serious grip of the cities' collars and reduce the quality of the urban spaces. These are problems that are also intensified due to the absence of clear-cut standards and scales for forming the spaces as well as absence of codified visual regulations. Furthermore, paying attention to the visual knowledge and codification of the rules regulating and ordering the visual environment are amongst the necessary needs of the today's urban designing (Pourja'afar and Alavi, 2012, pp.12-13).

Considering the issue of the energy expenditures' reduction and simultaneously creating comfort and favorable conditions for the houses' residents and also enhancing the positive bioenvironmental effects during the recent decades, discussions on green façades have caused growth of researches in this area in architecture and designing of the buildings and spaces based on the sustainable architecture principles. Based on this approach during the two recent decades, the use of the green spaces as well as the nature-intermixed spaces in the buildings has been developed in the buildings as a creative method for amalgamating the living spaces with the nature and elevating the quality of life based on the park structures in the constructed buildings (Karimi Demneh and Mortaza and Farzan Rasoulzadeh, 2013).

In the ecological models, the type and species of the vegetative cover, wildlife, ecological regions, sequence stages and other ecological indices constituting the landscape are amongst the most important landscape-indicating and -describing factors and form the visual qualities thereof (Daniel and Vinning, 1983).

Green buildings that are also known as the environment-compliant edifices are amongst the structures that provide the possibility of optimal exploitation of the valuable natural resources like water, wind, sun and so forth along with the recyclable and effective constructional materials.

The shortage of the open and green urban spaces and the increase in the land price, especially in the city centers and highly dense regions have become urban management challenges and phenomena. Considering the studies performed by Dr. Sofla'ei (2006) in Iran and in such a metropolitan as Tehran, about 60% of the fossil energy is annually wasted for heating and cooling the buildings and this is due to the failure in proper bioenvironmental designing in the contemporary period. His suggestion for the enhancement of the bioenvironmental quality and maximal sustainability of the architecture and urban engineering is the use of green roofs in the buildings.

According to the above-presented materials, it seems that there is a bilateral and mutual functional relationship between the architecture's ecological indicators and visual quality and that the visual quality indicators cause different effects appear on the landscape and view of the residential houses. Using plants on the roofs and creation of a space named garden roof and/or the use of crawling plants in the vertical surfaces of the buildings as green walls enables the reduction of the cooling and heating energy and, simultaneously attainment of the landscape's aesthetical principles in conjunction with green architecture.

Therefore, the following questions can be asked in this research paper in proportion to the study goals:

- 1) What are the most important ecological axes of visual quality and architecture?
- 2) How many indicators is each of these axes consisted of?
- 3) How is the functional relationship between the architecture’s ecological indicators and the visual quality?
- 4) How is the visual quality indicators related to the landscape of the residential houses?

Efforts were made in the present study to recognize the indicators existent in the architecture’s ecology and, then, determine the priorities according to the notions of the experts and ordinary people so as to determine the rates of their impacts on the visual quality in the designing of the houses, especially the buildings’ general view and landscape which is exposed to the onlookers’ view, and maximize the visual quality in the residential complexes and finally resolve the problems through offering proper solutions.

Final Theoretical Framework

Based on the abovementioned materials and the performed studies in this research paper, the primary axes of the architecture’s ecology in the residential complexes can be divided into four general axes:

- 1) The axis of connection with the nature;
- 2) The axis of vegetative cover;
- 3) The axis of green form; and,
- 4) The axis of land form (topography).

Table 1: the primary ecological axes

The axis of connection with the nature	Indicators	
1. Open Space	Yard	<ol style="list-style-type: none"> 1) Ordering the exterior physical environment using the open space designing 2) Keeping the residents more satisfied with the house via contributing to the designing of open space by adding natural elements like trees and grasses and plants 3) Enhancement of the residents’ social relations with the neighbors 4) Enhancement of the city-dwelling humans’ quality of life 5) Influencing the increase in the human beings’ longevity 6) Acquiring sensory, mental and psychological, social and physical interests 7) Enjoying the nature 8) Granting soul to the designed environment and return to the natural life 9) Perceiving the visual and semantic relationship between the house and the yard’s open space 10) Corroboration of the relationship between the human beings and nature and environment 11) Regulating the conditions and setting the ground for perceiving beauty and feeling comfort in the natural and manmade environments 12) Enhancing the quality of the open and green spaces and natural environments pertinent to the human activities 13) Managing the landscape’s visual manifestations and ecological processes
2. Semi-open space	Balcony	<ol style="list-style-type: none"> 1) Use of indentations and balconies for improving the building’s visual quality 2) Establishing relationship with the people’s daily life 3) Consistency between the soul and body and the intellect and mind’s power with the nature 4) Use of small and large clay pots in front of the porches for greening the space 5) Optimal use of the spaces in the small houses without yard even by placing several pots
The axis of vegetative cover	Indicators	

1. Dense	Trees	<ol style="list-style-type: none"> 1) Enhancing the level of comfort and tranquility in the residents and supplying more satisfaction to the people by creating better connection with the nature 2) Improving the quality of air 3) Protecting the building against the direct sunlight 4) Creation of protected and proper spaces for the residents inside the buildings 5) Creation of sensory and visual attractions by the independent colors or combining the color of the leaves, movable shapes of shadows and shades, leaves and fruits and textures' changes and landscape coordination 6) Creation of beauty 7) Controlling the light irradiations and the light reflections 8) Positive mental effects 9) Creation of beautiful landscapes and vistas and decoration of the environment and beautification of the urban environment 10) Concealing the ugly buildings and landscapes lacking the human scale 11) Human beings' better perception of the modern and industrial environments 12) Improving the visual quality by diversifying the vegetative cover's types
2. Surficial	Grass	<ol style="list-style-type: none"> 1) Use of a combination of three main plant types, namely trees, shrubs and soil coverings for making the space look natural 2) Creation of proper resorts
3. Linear	Shrub-Flower	<ol style="list-style-type: none"> 1) Satisfaction of the household 2) Coordination between the landscape and bringing diversity by the use of colorful plants
The axis of the green form	Indicators	
1. Green Roof	<ol style="list-style-type: none"> 1) Enhancing the resources' output and productivity and supplying the comfortable and favorable internal environment's conditions 2) Emphasis on the visual and physical communication with the nature 3) Positive bioenvironmental effects 4) Creative method for mixing the living space with the nature 5) Diversity in the green roof designing on the roofs and flat and sloped walls 6) Increasing the per capita of the green space 7) Improving the ecological conditions and preservation of the natural beauties 8) Preservation of the citizens' psychological and physical health 9) Increase in the economic and spiritual values 10) Increase in the beauty of the urban landscapes 	
2. Green wall	<ol style="list-style-type: none"> 1) Dense vegetative cover as a protection between the direct sunlight irradiation and the wall's exterior shell during summer 2) Creation of shade during summer and acquisition of visual comfort 3) Beauty of the building's façade hence the city's context 4) Creation of sustainable and strong and, in the meanwhile, tranquilizing natural and native urban communities and landscape 5) Combination with the peripheral natural environment by taking advantage of the various plant species 6) Diversity in designing 7) Creation of habitat for various plant species and attraction of the living species and birds and preservation of the biodiversity and ecology 8) Improving the status of the visual organization of the buildings with uncommon facades and attached blocks in the city 9) Improving the bioenvironmental conditions in the dense urban spaces 	
Axis of land form (topography)	Indicators	
1) Slope direction	<ol style="list-style-type: none"> 1) Better perception of the distant landscapes 2) Selection of the optimal route for paving roads and pedestrians and vehicles' access 3) Designing symbiotic buildings consistent with ecosystem processes 4) Formal ideas of designing by inspiration from the land form and nature 5) Ecological ground-orientation and veneration of the environmental capacity in the intervened bed and complete cycle of the building life 6) Coordination with ground bedding and topography by considering the site's balance lines in designing building and achievement of sustainable architecture 7) Buildings' southward orientation and use of favorable sunlight 	

2) Location	On the rises and falls	<ol style="list-style-type: none"> 1) Enhancing the comfort level inside the building by the assistance of the shape and placement style of the building and location of its interior spaces 2) Creation of interaction between the building and the site 3) Better perception of the orientations in respect to the sun and the quality of the building's placement in the site 4) Preservation of the peripheral environment and access system of the vehicles and pedestrians 5) Improving the quality of landscape based on the naturalness and integrity of the ground ecosystems 6) Creation of diversity in the designing elements in terms of form, shape, color, texture and lines and the sensitivity levels of the landscapes
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Based on the studies performed in this study, the main axes of the visual quality in the residential complexes, as well, can be divided into two general axes:

- 1) The axis of visual comfort
- 2) The axis of the aesthetics

Table 2: the main axis of the visual quality

The axis of visual comfort	Indicators
1) Color	<ol style="list-style-type: none"> 1) The colors' match with the spirits and culture of the people and the city's climate 2) Creation of a tranquilizing and lively sense and diversification by creating color unity in the whole city 3) Use of green as the color of nature, tranquility, silence, balance, security, life, growth and success 4) Moderation of the sunlight's intensity in summer by the assistance of green 5) Use of the green nature, plants and crawlers as the symbolic green color in the building and creation of a sense of reconstruction and life
2) Environmental quality (visual)	<ol style="list-style-type: none"> 1) Enhancement of the residents' comfort level 2) Supplying visual comfort by coordinating the buildings, trees, nature, water, traffic, advertisement signs and so forth 3) Beauty of the facades of the buildings and the city's contextual environment
The axis of aesthetics	Indicators
1) Rhythm	<ol style="list-style-type: none"> 1) Sense of pleasure in the peripheral environment 2) Creation of social life and memorability with the presence of the nature 3) Inducing beauty into the environment and creation of beautiful spaces by the assistance of the nature and natural elements 4) Creation of ecological beauty and health, diversity and sustainability and stability 5) Proper and proportional siting of the constituents in a larger spatial structure and creation of visual comfort and beauty 6) Beauty of the intact nature kept immune of the human interventions 7) Supply of the ecological balance and individuals' mental satisfaction and creation of beautiful landscape
2) Proportion	<ol style="list-style-type: none"> 1) Use of vegetative cover in proportion to the façade's design and plan 2) Creation of the natural visual factors in coordination with the visual mechanisms 3) Elimination of the psychological-mental and behavioral confusions by bringing about visual proportions

Study Method

The present study is an applied research in terms of nature and uses a combined study method. At first, the content obtained through library research is analyzed and the architecture's ecological indicators as well as the indicators influencing the visual quality of the residential complexes are carefully investigated. Then, using Delphi method and acquiring ideas from the architecture and urban engineering experts, the indicators with higher importance will be extracted. Next, using a survey method and administering questionnaires to the residents and acquiring ideas from them in this regard, the maximal effects of these indicators on the improvement of the visual quality will be evaluated.

Step One: Content Analysis Method

Considering the studies performed in this research paper, the architecture's primary axes can be divided into four in the residential complexes; these four axes can be further categorized in the form of 9 macro-level and 66 micro-level indicators.

- 1) The axis of connection with the nature
- 2) The axis of the vegetative cover
- 3) The axis of green form
- 4) The axis of land form (topography)

Based on the studies performed in this research paper, the main axes of the visual quality in the residential complexes can be also classified in the form of two general axes which are per se composed of 18 sub-indicators.

- 1) Axis of visual comfort
- 2) Axis of aesthetics

Step Two: Delphi Method

At first, a list of 15 architecture and urban engineering professors from Tehran University was prepared. Then, questionnaires were administered to them in person or through email. In the end, 8 completed questionnaires were collected and their results have been analyzed beneath.

The experts gave scores from 5 to 1 to each of the indicators constituting these axes based on its degree of importance with 5 designating the highest importance and 1 denoting the lowest importance. Eventually, the final weights of the indicators were averaged.

Step Three: Survey Method

In this study, a questionnaire was designed for achieving the priorities of the residents in Sa'adat Abad's Kouy Faraz Neighborhood regarding the architectural ecology indicators and their effects on the visual quality indicators in residential complexes.

Sample Volume Selection

The study population was the Kouy Faraz Neighborhood and the upper section of Shahid Zabihi Boulevard. 34 of the residents were selected based on random sampling as the study sample volume.

The questionnaire contained 17 questions and the study sample volume was selected two times the number of the questions, i.e. 34, based on Cline Method. The questions were theoretically and pictorially designed based on the indicators chosen in the previous section.

Data Analysis Method

In order to analyze the questionnaire's data and obtain the weighted mean of each question for comparing and evaluating them in respect to one another, Likert's scale was utilized. The required information was extracted through library and field research, map analysis, questionnaire preparation and data analysis in SPSS and Excel.

The information extracted from each of the questions is in this form that a coefficient was allocated to each of the options in multiple choice span questions through counting the frequency of each option's selection and determination of its percentage in respect to the total number of the given answers.

Findings

Demographical Information

Table 3: the number and the age percentage and span of the respondents in separate based on gender (author)

Gender	Female		Male		Total	
	N	%	N	%	N	%
Number and percentage	19	56	15	44	34	100
Gender	Female		Male		Total	
Age span	17-47 years		22-56 years		17-56 years	

Based on the results of table (3), the people live an active life in Sa'adat Abad's Kouy Faraz Neighborhood and there are individuals from all the age groups present therein. Thus, the living conditions should be improved for all of the social classes and their ideas should be applied in designing.

Delphi Method's Findings

After investigating the results and the final scores, 9 architectural ecology indicators with large deal of effects on four visual quality indicators were found resulting in a total 56 crisscross indicators. 28 indicators with higher importance were selected to be directly used in acquiring ideas from the residents hence designing. In all of the axes, the indicators with scores equal to and or above 3.40 were selected (table 4).

Table 4: the indicators of the axes of connection with the nature, vegetative cover, green form and land form with highest effect on the indicators of visual quality (author)

Architectural ecology	Axis of connection with the nature		Visual quality: visual comfort	
	Open space	Yard	Color	4
	Open space	Yard	Environmental quality	4.125
			Visual quality: aesthetics	
	Open space	Yard	Rhythm	3.625
	Semi-open space	Balcony	Rhythm	3.5
	Open space	Yard	Proportion	4
	Semi-open space	Balcony	Proportion	4.375
Architectural ecology	Axis of vegetative cover		Visual quality: visual comfort	
	Dense	Trees	Color	4.375
	Surficial	Grass	Color	4
	Linear	Shrub-flower	Color	4.125
	Dense	Trees	Environmental quality	4.75
	Surficial	Grass	Environmental quality	3.75
	Linear	Shrub-flower	Environmental quality	3.75
			Visual quality: aesthetics	
	Dense	Trees	Rhythm	3.5
	Surficial	Grass	Rhythm	4
	Linear	Shrub-flower	Rhythm	4
	Dense	Trees	Proportion	3.625
Linear	Shrub-flower	Proportion	3.625	
Architectural ecology	Axis of green form		Visual quality: visual comfort	
	Green roof		Color	3.875
	Green wall		Color	4.625
	Green roof		Environmental quality	4.25

	Green wall	Environmental quality	4.75
		Visual quality: aesthetics	
	Green wall	Rhythm	3.375
	Green wall	Proportion	4
Architectural ecology	Axis of land form	Visual quality: visual comfort	
	Dip	Environmental quality	4
	Placement location	Environmental quality	4.25
		Visual quality: aesthetics	
	Dip	Rhythm	3.625
	Placement location	Rhythm	4.125
	Placement location	Proportion	3.875

Survey Method's Findings

The results obtained from the studies are as explained below:

In Sa'adat Abad's Kouy Faraz Neighborhood, people live an active life and there are individuals from all age groups therein. Thus, the life conditions should be improved for all the social classes and age groups and their notions should be acquired for designing (table 3).

Table 5: final weights of the solutions and suggestions for enhancing the visual quality based on the residents' prioritizations (authors)

Indicators	Suggestions	Final weight
Axis of connection with the nature	Existence of yard in the house	3.47 out of 4
	Diversity in the method of tree planting in yard	3.17 out of 4
	Existence of balcony in house	1.97 out of 2
	Planting flowers and tall shrubs in balcony	2.3 out of 3
	Designing protruded balcony or balconies with plain walls	2.15 out of 3
Axis of vegetative cover	Diversity in the plants' sowing method	1.62 out of 2
	Use of tall plants	2.5 out of 3
	Existence of flower and natural shrubs in balcony	3.5 out of 4
	Existence of various kinds of vegetative cover in balcony	1.94 out of 2
	Existence of various kinds of vegetative cover in yard	1.97 out of 2
	Sowing plants in all the open spaces' walls	3.06 out of 4
Axis of green form	Creation of green roof	3.03 out of 4
	Creation of green wall	3.2 out of 4
	Combining green roof and balcony	3.82 out of 5
Axis of land form	Construction of houses on elevations	2.59 out of 3
	Placing the house in the same orientation with dip	2.59 out of 3

Conclusion

The present study aimed at identifying the architectural ecology indicators in designing residential complexes based on visual quality enhancement. Based on the study findings, the architectural ecology indicators usable for enhancing the visual quality can be expressed as outlined beneath:

- 1) Designing landscape in match with the site's green bed
- 2) Designing green roof in line with stability and sustainability
- 3) Optimization of the energy consumption through the use of green roof
- 4) Green roof for creating beautiful landscape and improving the visual quality
- 5) Use of terrace for enjoying the site's natural landscapes
- 6) Designing green terraces with the objective of visual enjoyment and social interactions
- 7) Creation of interaction between the adjacent neighborhoods and inducement of a sense of attachment and belonging to the place
- 8) Brick-laid walls of terraces as supports for growing crawlers and creation of proper landscapes
- 9) Granting green nature to the neighborhood's residents using various kinds of vegetative cover in the wall and shelter of the terraces
- 10) Use of grasses' greenness on the roof and terraces

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