
INTEGRATION OF NATURAL ELEMENTS INTO THE TRADITIONAL HOUSE (OF KHOREZM REGION, UZBEKISTAN) FOR THE CLIMATE IMPROVEMENT

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Abstract: This article is dedicated to the analysis and recommendations for the solution of a number of landscape problems related to architecture in the Khiva city. In particular, the advice is given on the use of methods such as "Chor-minor", "Chor-bag", which had existed in the Middle Ages.

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1. INTRODUCTION

Khorezm is one of the ancient regions with a very rich history. In the past, the territory of Khorezm was much larger than today, covering a certain part of the territory of Turkmenistan and the Republic of Karakalpakstan. Khorezm is bordered on the north by the Aral Sea, on the east by the Kyzylkum, on the south, on the southwest by the Karakum and the west, and on the northwest by the deserted Ustyurt Desert. The Amudarya, the largest river in Central Asia, flows along the south-eastern and north-western sides of the Khorezm region. Thus, Khorezm was separated from other regions of Central Asia due to the fact that it was surrounded by deserts on three sides. It was connected with the provinces by caravan routes, which were very scarce. The most important of these is the trade route through the banks of the Amudarya. This trade route ensured that Khorezm was in constant contact with India and the Volga region. Such a geographical location has influenced the way of life and culture of the Khorezm population (Khasanov 2015). Rural housing - the complete architecture of residential houses and the unique environment of the living environment cannot be protected without considering the territorial natural and climatic aspects. At the modern stage of architectural development, the urgency of this problem is growing day by day in connection with the protection of the environment and the growing aesthetic demands in society (Lefevre 2011; Nazarova 2013, 2014). Khorezm oasis is characterized by its dry and hot climate, temperature, winds, humidity, radiation, insulation, aeration, lighting, and landscaping are considered important factors of the climate of this region. Compared to other regions of Uzbekistan, the climate of the Khorezm oasis is much sharply variable. The Khorezm oasis is second only to Termez in terms of global warming.

2. MAIN CLIMATIC ZONES

Khorezm region absolute maximum temperature rises to 50 °C. At 16⁰⁰, the temperature reaches its peak, at which point the sun's rays coming from the southwest side of the apartment buildings have their effect. Therefore, it is not advisable to turn the windows of the building in this direction. Windows facing this side are required to have much higher thermal resistance qualities. Many positive ideas on the use of natural and climatic conditions in the folk architecture of Khorezm have been implemented. The territory of Central Asia is divided into three main natural zones: zone I - zone of active desert climate influence (climatic zones IV A and part IV G), zone II - zone with favorable landscape-climatic conditions (climatic zones IV G and III B); III - zone with extreme cold conditions (high mountainous areas, climatic zones I B and II B). The first and second zones differ radically (sharply) from each other depending on the landscape-climatic conditions. The first zone is characterized by adverse climatic factors, and this zone is characterized by a bright-looking landscape with scattered landscape conditions. If in areas with good climatic conditions, with maximum use of the surrounding landscape, the houses will be located in the open to nature, and in the areas of the desert, where the climate is actively affected, the houses will be built indoors and compact (Mahkamov, 2019).

2.1. Aeration on traditional houses

Khorezm oasis belongs to the first zone, which in turn requires the organization of housing on the principle of "volumetric spatial structure" and the protection of the living environment. This principle is reflected in the organization of the indoor yard. Such an indoor yard serves as a means of accumulating cool air in the summer. The main advantage of an indoor courtyard is, of course, the protection of the apartment building from the scorching heat in the summer. The microclimate function of an indoor courtyard can be understood in two ways. First of all, the constant cool weather of the indoor yard creates good conditions for household chores and recreation for all members of the family in the hot summer season. Second, this spacious enclosed structure directs cool air to all the rooms around the courtyard and allows you to maintain a constant microclimate inside them. The speed of air flow in this oasis depends on the nature of the multi-faceted surface plane. In the periphery of the country (around) the speed of air flow is higher than in its center. At the same time, the wind is weak in the central part of the country, but its vibration amplitude is relatively low. Based on the research, the width, height and length of the building, the slope of the roof, the orientation of the building and the number of windows in it, the canopies and awnings have an impact on the speed of air flow. The Khorezm oasis is one of such elements of traditional dwelling houses - it is the installation of umbrellas over the high porch spaces.

These umbrellas create good conditions to catch the wind and allow the wind to pass directly to the innermost bottom of the yard. The natural ventilation, air exchange, aeration of the living rooms of residential houses depends on the difference in temperature inside and outside the building, as well as the thickening and thinning of the air under the influence of wind. In order for the temperature difference to create a constant air flow, the window gaps between the air outlet and the inlet must be located at different levels of the building. Khorezm residential houses require geometrization of the chilled air in the evening at some hours, and ventilation of the rooms at other hours of the day. The lighting of the rooms is subject to the rules of aeration and radiation of the interior rooms, provided that the installation of protective devices for windows is observed. It is important to place the windows relative to the sun. South-facing walls conduct less heat in summer than east-facing walls. The best orientation for summer rooms is to the north, and for winter zones, which require maximum heat, the best orientation is to the east, then the west and south sides do not lose their importance in this regard. The higher energy efficiency of solar radiation in the Khorezm oasis creates a more expedient orientation in accordance with generally accepted rules. But in addition to heat transfer through sunlight, builders also have to reckon with the lighting mode.

Although the summer rooms are mainly oriented to the north, they provide sufficient light for all conditions, as in this area in the summer there is a much longer duration of the day and the intensity of light. For winter rooms, it is necessary to choose an orientation that will ultimately achieve maximum heat and light. In winter, more south-facing walls are illuminated by sunlight, while restored walls facing east and west receive the most amount of heat. Khorezm masters in their construction practice reckon more with the long duration of the scattering of sunlight. Thus, the sides of the types of buildings are exposed to heat, which differs significantly from each other. Such diversity of thermal effects indicates that there are continuous correlations between the amounts of solar radiation and orientation received along the sides of the building where the sun's rays fall. In climatic conditions, the main components of which are rain and snow, two-sloped (sloping) roofing not only justifies itself, but also actively participates in the creation of the architectural and artistic image of rural residential buildings. Due to the low incidence of fires in the hot and dry climates of Central Asia, especially in the Khorezm oasis, double-sloped roofs do not justify themselves, both functionally and aesthetically. Low rainfall in Khorezm requires roofing on a small slope. In desert conditions, one of the ways to connect the dwelling with the external environment is to use a walled enclosed form of fencing with high thermal protection properties, as such a form provides good insulation of the house from various harmful effects of nature. In modern rural houses of Khorezm it is more common to cover the verandas with windows, which have a poor orientation to the sun. Glass-covered loggias or verandas can be allowed to orient in a northerly direction when they are protected from returning heat rays (streams). Typically, a residential courtyard on the north side of the house receives heat radiating from the direct falling rays of the rising sun as the sun sets toward the sunset (Gulyamov 1941).

3. FUNCTIONAL PROPERTIES OF GARDENS

The historically formed rural settlements of the Khorezm oasis are distinguished by a certain contrast of natural and mastered landscape, which has its own distinctive features. In this oasis, the main focus is on the priceless traditions of the garden in front of the residence. The gardens of the settlements of this region are characterized by the fact that the specific natural and climatic conditions of Khorezm rural houses, made of the material that forms the basis of the surrounding landscape, require consideration of the following measures:

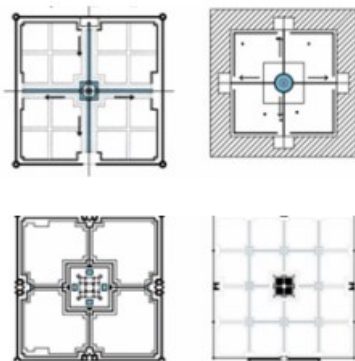
- creation of living environment on the principle of "space within volume", as opposed to the principle of "volume in space".
- Protect the architectural environment from overheating under the influence of sunlight and increase the ventilation of this environment by orienting it to the north or northeast or at least east.
- Many Tsar-gardens that existed in the Central Asian region in the Middle Ages. None of the meadows and other types of garden structures have survived to the present day.

Table 1. Classification of Timurid gardens according to their functional features

№	Functional features	The names of the gardens	Year
	Gardens with palaces	1. Bagi Dilkusho 2. Bagi Nakshi Jaxon 3. Bagi Baland	1396-1399yy. 1370-yy -
II	Gardens for hunting	1. Bagi Jaxonnomo 2. Bagi Bekhisht 3. Takhta Karacha	- 1378y. -
	For the king and his family members	1. Bagi Shamal 2. Bagi Bekhisht 3. Garden Amirzoda Shahrukh	1397y. 1378y. 1394y.
III	Gardens for discussion and poetry nights	1. Bagi Boldu	-
IV	Multifunctional gardens	1. Bagi Maydan (with a pavilion garden with a playground for the game of Chovgon, with a two-story Chil-ustun Palace and a porcelain room gallery. 2. Bagi Davlati-Obod (Garden, exotic plants, legumes and vineyards)	1435-1436yy. 1399y.
V	Public parks	1. Bagi Zagan (on the way to Pandjikent) 2. Bagi Chinar (on the bank of Dargam river) 3. Bagi Nau (luxury public garden)	- - 1404y.
VI	Gardens with fortress	1. Boston Palace "Fruit Garden Palace" 2. Garden under the Blue Palace in Samarkand; Garden near the White Palace in Shakhrisabz	- 1370y. 1379y.
VII	Memorial gardens	1. Darus-Saodat family mausoleum in Shakhrisabz 2. Hodji Ahmed Waqf Park near the Yassavi Mausoleum in Turkestan 3. Parks at the Samarkand mausoleums: 4. Gori Amir 5. Workshop, 6. Hodja Ahror, 7. Abdi-Dorun 8. Abdi-Berun 9. Char-Bakr and Bahauddin in Bukhara.	- 1402-1405yy. 1397y. - - - -

Thus, based on the data on Timurid parks, it can be said that the parks are divided into 4 types (for cities, for suburbs and for recreation zones). Depending on the species, they contribute to the development of various industries. In particular, foreign and domestic industries will open new tourist destinations, such as eco-tourism, national cultural centers. In addition, boulevard and alley-shaped parks play an important role in the wide celebration of national holidays and thus in combining our ancient traditions with modern lifestyles.

a) Garden in horizontal zone



b) Garden in the shape of perimeter

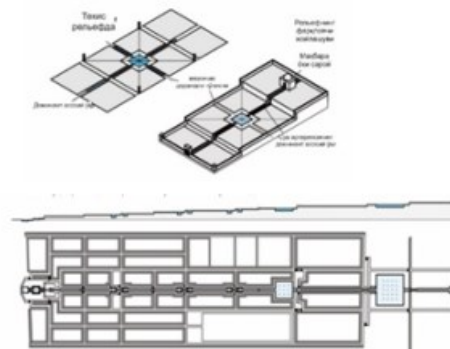


Figure 1. "Chor-bog" traditional water structures. Irrigation of "garden": a) horizontal surface in the plain; b) perimeter construction; c) relief plane, at a slope of 2-10%.
The illustration is made by author.

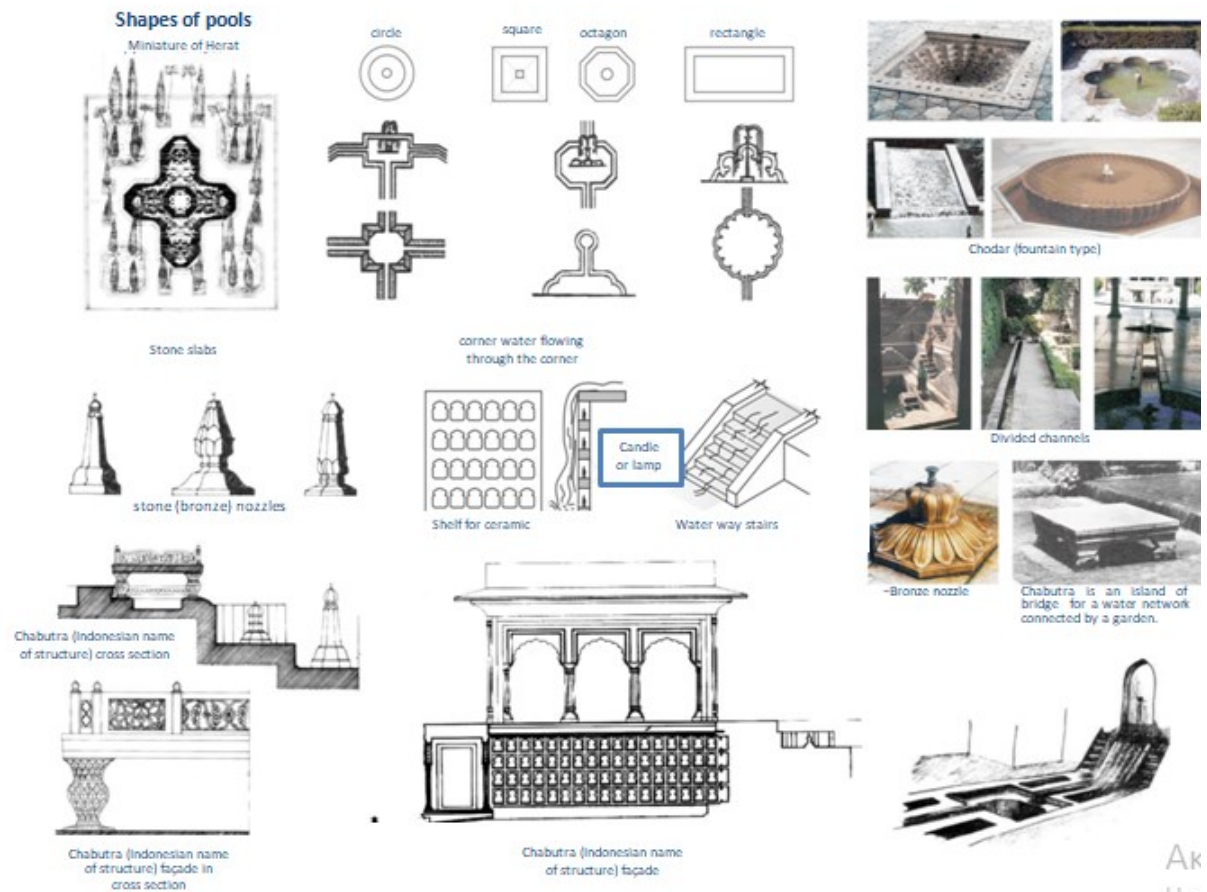


Figure 2. Recommended water basins and rock slabs for waterfalls in light differentials. The illustration is made by author.

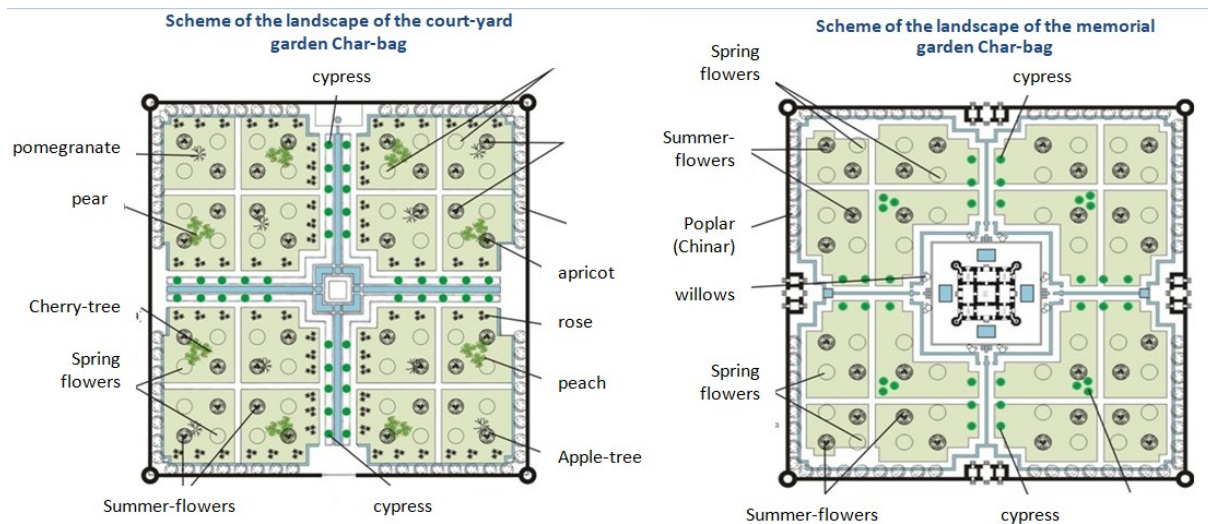


Figure 3. Requirements of the traditional scheme of landscaping "Chor-garden". The illustration is made by author

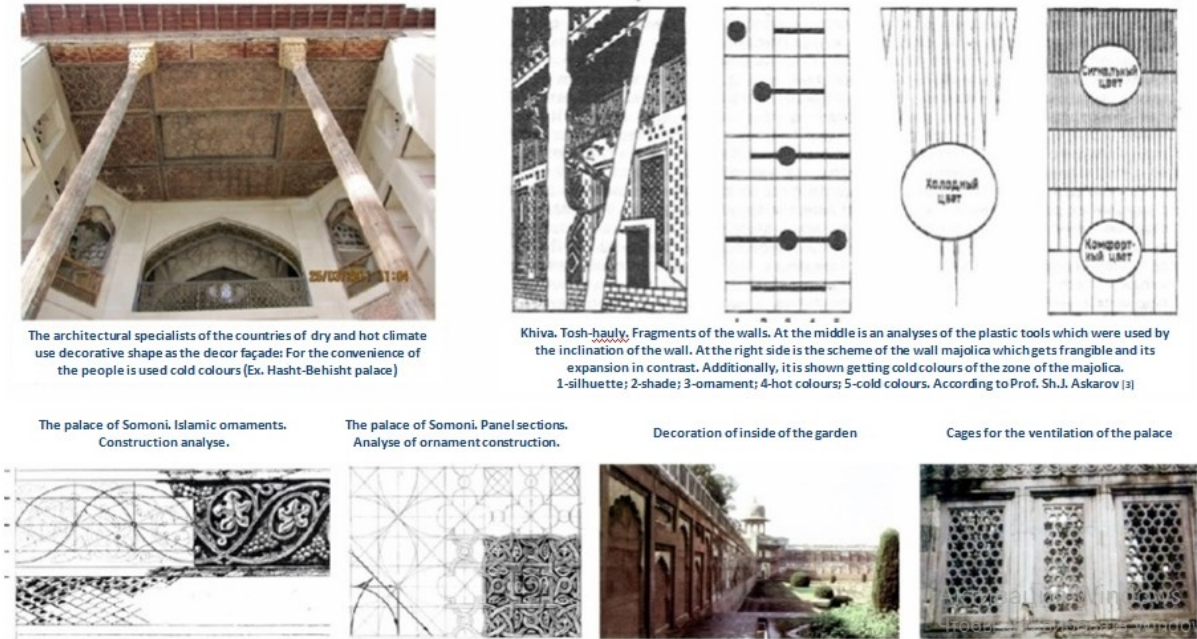
However, we can find out what it was like and in what order the trees were planted by our scientists, archaeologists and architects. In particular, the classification of these trees, developed by Akhmedov (1995, 2014), gives us a lot of information about the gardens .

Table 2. Psycho-emotional effects of various plant compositions (Karmazin Kakovsky, 1987)

№ types	Plant compositions and their psycho-emotional effects
1 and 2	A space with sharply connected trees and shrubs emphasizes a more orderly (disciplined) activity, as opposed to spaces with arbitrary or artistically figured trees. In our example, there is a "Chor-garden" garden planted along the perimeter of the logs along the walls.
3 and 4	In addition, geometrically cut trees and shrub shapes encourage intense activity because clearly defined and beautiful groups contribute to conflicting movements (e.g., Shalimar Park in Lahore).
5 and 6	The scheme of the plant can be directed to a specific point (in Shalimar Park, Taj Mahal, trees in asymmetrical location on both sides of the main trunk draw attention to the mausoleum) or to replace it with groups of ornamental trees.
7 and 8	Large trees lose their expressiveness when compared to trees. The comparison between large and small trees is well represented by relationships and dimensions; their position is more deeply expressed as a result of the contrasting impression (usually the Chor-Garden scheme, where high and low fruit trees are planted along the perimeter).
9 and 10	The columnar and pyramidal shapes of the trees give an idea of the height (Kashan Garden in Iran), but the width of part of the umbrella-shaped, domed trees. ("Itimod ud-State Park", "Lahore" Park).
11 and 12	A sense of stability is provided by groups of pyramidal trees, while trees gathered in the form of a bouquet cannot create stability.
13 and 14	Trees with a round, compact shape better represent ideas of completeness, perfection, yet trees planted in different directions leave a dull, unfinished impression.
15 and 16	Trees with a round or oval shape of the mountain, while festive, are also stronger than those with a columnar shape that has a serious appearance.
17-18 and 19-20	The crowns of unorganized or curved horned trees are more impressive than those with long, narrow, vertical trunks with hornless buds that rise vertically or cause a certain static impression.
21, 22 and 32	Harmony in European kindergartens is achieved not only in a symmetrical order, but can also depend on asymmetric groups. The beautiful forms of such groups sometimes leave an unforgettable impression.
23 and 24	The silhouettes of large groups of trees in the landscape can give a state of tranquility using horizontal shapes, and the stepped silhouettes create a chaotic atmosphere.
25 and 26	The silhouettes of groups with rounded upper horns (crowns) of trees create a more calming environment than those with sharp horns (crowns).
27 and 28	Compact plants with the support of compact plants represent stability, precision, safety and resilience, but compact plants with uneven crowns give the impression of uneven, safe and uncertain.
29 and 30	Plants with bright green leaves or brightly colored flowers are more noticeable if they are highlighted and placed forward in the dark hue of the trees. On the contrary, the contours of dark plants are well represented in front of them, and conversely, the contrast is drawn to a bright background.
31 and 32	Two fruit trees, such as a lemon and a citrus, a lemon and an orange, wrapped between a flowerbed or a cypress tree planted by two pairs of trees, symbolized happy lovers. They create a sense of surprise, good intentions, joy.
33 and 34	The weeping willow symbolizes the grief of the famous Majun as Lily merges with the water lily that falls into the water.
35-36 and 37-38	While the dark purple-purple, blue-black represents Lily's hair shine and scent, jasmine is a symbol of Lily's elegant white neck. The cypress tree is her delicate waist, the tulips and flowers are her lips and cheeks, and the narcissus flower is the hadid in her eyes.
40	The aesthetic ripening of herbaceous plants and fruits based on the principle of continuity of flowering in Central Asia is astonishing, and leads to enthusiasm, renewal. However, the choice of tree species in Europe is made according to the principle of irrigation, taking into account the fact that in autumn the leaves turn yellow and form a beautiful bouquet, which gives a melancholy mood or upset.
41	With the predominance of one type of flower, the garden areas give a strong impression of the scale of a flowerbed and its contrasts with other places. (North India).
42 and 43	Planting deciduous trees along the main axis of the garden means "eternity" and emphasizes the importance of the mausoleum or building. Planting flowers in the lateral parts of groups of fruit trees - a symbol of renewal of life and youth. (Taj Mahal).

44 and 45	Accepting the planting of flowers on the lowered sheets not only reflects the geometry of the design, it gives the impression that the flower is walking on the carpet. The guest touches the flowers and fills the air with pleasant scents of fragrant herbs, which bring pleasant feelings and aesthetic pleasure (the gardens of Alhazar in Seville and the courtyard of Qasir al-Mubarak).
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Architectural decoration of the palace



The architectural specialists of the countries of dry and hot climate use decorative shape as the decor façade: For the convenience of the people is used cold colours (Ex. Hasht-Behisht palace)

Khiva. Tosh-hauji, Fragments of the walls. At the middle is an analyses of the plastic tools which were used by the inclination of the wall. At the right side is the scheme of the wall majolica which gets frangible and its expansion in contrast. Additionally, it is shown getting cold colours of the zone of the majolica.
1-silhouette; 2-shade; 3-ornament; 4-hot colours; 5-cold colours. According to Prof. Sh.J. Askarov [3]

The palace of Somoni. Islamic ornaments. Construction analyse.

The palace of Somoni. Panel sections. Analyse of ornament construction.

Decoration of inside of the garden

Cages for the ventilation of the palace

Figure 4. Architectural decorative wall gardens.
The illustration is made by author according to Askarov (2009)

Alleys and pedestrians

The decoration of the garden construction and covering with stone, baked clay brick of the pedestrian. It is esthetic connected with Char-bag style.



The different geometric shapes for the pedestrians and alleys

The ornaments by brick around pond. Gardens of Alhambra, Spain

Stone, Alhambra, Spain

marble mosaic of the floor of the palace

Figure 5. Use of natural materials for the walkways in the traditional garden "Chor-garden".
The illustration is made by author

4. CONCLUSION

Conflict situations in the Khiva urban landscape were assessed and on this basis measures were developed to address the problems.

The use of new innovative technologies in the landscape, in particular the use of new aspects of modern "Light Architecture" to further enhance the decorative properties of light green environments (for example, self-illuminating barriers, garlands, radiant umbrellas, self-reflecting tiles on the floors of landscape architecture, through the use of geoplastics) we can give a new tone to the quality of landscape architecture of our city.

We offer the use of historically tested methods "Chorbog", "Chorchinor" and "Chorchaman" in shaping the landscape of alleys, open and closed green spaces on the basis of national values of our art.

And eke given the hot and dry climate of our city and the long summer, it is expedient to use the opportunity to achieve the effect of "wind" in the landscaping of urban areas and in the art of gardening.

It is proposed to raise the level of architecture of open spaces to a higher level by applying various decorative compositions of mobile and container-grown flower beds in the landscaping of the fronts and sidewalks of prestigious public buildings in the city, Ichan Kala streets.

The scheme of creating a favorable environment for human life in historical centers is proposed.

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