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Research Paper

Understanding the impact of high-rise buildings on environmental quality and sustainable urban development.

Abdi F.

J. Art Arch. Stud., 8(2): 13-18, 2019;

pii:S238315531900003-8

DOI: <https://dx.doi.org/10.51148/jaas.2019.3>



ABSTRACT

Nowadays, increasing population and land prices have made high-rise construction or the vertical growth and development of cities to become inevitable. The benefits of vertical urban growth include preserving arable land to supply and feed the growing population, reducing environmental degradation due to reduced natural land construction, reducing urban traffic and energy consumption, and reducing air pollution resulting from horizontal urban development. The purpose of this paper is to investigate the effects of high-rise building on environment quality and sustainable urban development using a descriptive-analytical research method. The research process has concluded that high-rise buildings can meet the needs of the community based on feasibility studies and design and construction based on appropriate scientific and technical and managerial principles and in accordance with the advanced technologies required for such buildings, such that all the principles and criteria of high-rise building are met.

Keywords: High-rise construction, Sustainable development, Sustainability, Environmental quality.

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Research Paper

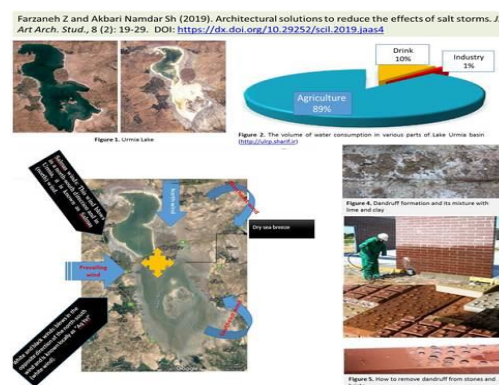
Architectural solutions to reduce the effects of salt storms.

Farzaneh Z and Akbari Namdar Sh.

J. Art Arch. Stud., 8(2): 19-29, 2019;

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ABSTRACT

With an increased level of salty and saline land in the region around Lake Urmia followed by powerful winds and the creation of salt dust, the agricultural lands of the region progressively move towards salinization and eventually desertification. Environmental adverse effects of salt dust in the dried areas of the lake, which is the chief source of this problem, can be minimized by drainage. In more detail, by continual or sporadic flooding methods or by sprinkler irrigation and precipitation, soluble salts can be washed from saline soil profiles. Object-oriented image analysis (OBIA) techniques are one of the latest means of satellite image processing in the scope of remote sensing. These techniques have significant potential in soil science studies. The application of soil improvers to advance the physical and structural characteristics of the soil is quite common. This study is of review and descriptive type, and the collection of resources in this study was a library method and by reviewing Internet resources. The results of this research suggest relevant architectural and urban design solutions to reduce physical vulnerability to storms. In this respect, solutions have been given.

Keywords: Salt Storm, Architectural Solutions, Soil Improvers, Climate

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Sick building syndrome: natural daylight case study.

Akbari Namdar Sh and S Tabe Afshar.

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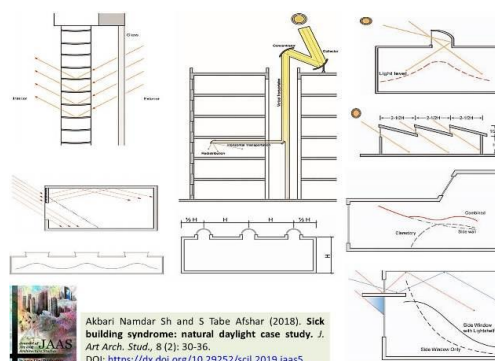
ABSTRACT

ABSTRACT

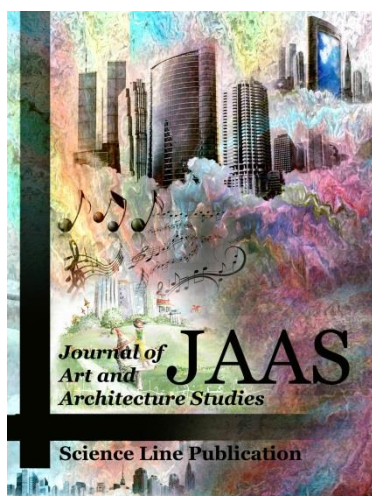
In the taxonomy of creatures, human is a complex being, a feature that makes him vulnerable, such that if he lacked the power to reason and intelligence, he would certainly not be able to deal with the threats of the nature. Creating a shelter, from its primitive form for cave dwellers to today's luxurious buildings, all point to the man's need for privacy that primarily guarantees his security, but a closer look at this physical boundary between man and nature, which is known as residence, reveals that there are a plethora of problems, questions, and requirements besides security, ranging from the extent to which nature suffers as a result of construction to the health problems that this demarcation creates for humans. Evidently, not being attentive to the environment will result in health problems, but since sustainable architecture is not necessarily considered a moral obligation to care for the health of residents, developing building regulations and design policies with an emphasis on human health seems essential. One of such problems, whose consequences are clearly noticeable in current societies and families, is the lack of access to natural daylight as a result of increased unorganized constructions and regardless of environmental conditions, and ultimately the emergence of dysfunctional buildings for their residents in the community, which in turn will eventually bring about irreversible physical and mental problems. In this article, the notion of "Sick Building Syndrome" (or SBS for short), and its underlying causes are reviewed by conducting a series of studies on authoritative and up-to-date sources, articles, and books. Here, the role that natural daylight plays as one of the major elements whose lack or absence will lead to the formation of a sick building in society, along with the factors and elements contributing the increased prevalence of this type of building are studied in the scope of architectural designing. The authors believe that identifying the reasons for the rise of acute health problems in our current society and promoting builders and architects to use appropriate and low-cost solutions, will greatly alleviate these problems.

Keywords: Sick Building Syndrome, SBS, Daylight, Architecture & Health, Architectural Design

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UNDERSTANDING THE IMPACT OF HIGH-RISE BUILDINGS ON ENVIRONMENTAL QUALITY AND SUSTAINABLE URBAN DEVELOPMENT

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Original Article

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ABSTRACT: Nowadays, increasing population and land prices have made high-rise construction or the vertical growth and development of cities to become inevitable. The benefits of vertical urban growth include preserving arable land to supply and feed the growing population, reducing environmental degradation due to reduced natural land construction, reducing urban traffic and energy consumption, and reducing air pollution resulting from horizontal urban development. The purpose of this paper is to investigate the effects of high-rise building on environment quality and sustainable urban development using a descriptive-analytical research method. The research process has concluded that high-rise buildings can meet the needs of the community based on feasibility studies and design and construction based on appropriate scientific and technical and managerial principles and in accordance with the advanced technologies required for such buildings, such that all the principles and criteria of high-rise building are met.

KEYWORDS: High-rise construction, Sustainable development, Sustainability, Environmental quality.

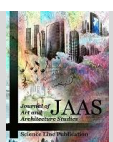
INTRODUCTION

High-rise construction is a phenomenon that emerged in the world from the late 19th and early 20th centuries, and the first steps in the constructions of skyscrapers were taken around years 1880 to 1900 in Chicago. With the increasing population worldwide and the growing demand for housing, human beings have tried to meet this need in many ways. Among these practices is the tendency towards towers. This can be considered a fundamental phenomenon in the current urbanization. Today's demands especially population and urbanization growth, have pushed authorities to promote urban growth, to construct high-rise buildings, or, in other words, vertical urban growth. Today, many urban plans are based on increasing the density and construction of high-rise buildings and focusing on mixed-use, as much as possible, to reduce the occupancy level of buildings to optimally utilize urban land, so that a proper relationship can be achieved between 'residential, labor, leisure and travel' functions at the city level and to establish a suitable living environment for today and future generations [1]. The rapid growth of the urban population and consequently the need for housing on one hand and preventing the unnecessary expansion of cities for optimal use of urban land and the resolution of problems, land, space, land use, environmental issues, urban transport, etc. on the

other hand, has put forward the "high-rise construction" and the "compact city" model for sustainable urban growth in developed and developing countries. Sustainable Urban Development emphasizes the role of high-leveling in "coordinating the functions of residence, labor, meeting essentials and leisure", as well as optimizing the use of urban land. But as the high-rise development continued in the 70th to 50th decades, and with the rise of tall towers built in various cities around the world, political reactions took place to control vertical growth. These tensions were mostly due to the problems of high-rise construction that plagued the cities. This issue led to efforts to address the shortcomings and to adopt lawful policies for the high-rise construction process to move towards sustainable urban development [1]. High-rise construction has been able to address many urban issues such as land scarcity, housing scarcity, etc. on one hand, but on the other hand it has caused other problems and irregularities. Western countries have tried to take advantage of high-rise construction and to control the arising issues and problems under applicable laws and regulations. In this regard, our cities are now witnessing the growth and development of high-rise buildings while there is no proper recognition of the importance of the issue and no controlling laws and regulations are available. The year 1950 can be considered as the beginning of the high-rise construction movement in

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Iran. With the outbreak of the Islamic Revolution, high-rise construction was ceased for almost five years. During these years the construction of these types of buildings was limited to the completion of unfinished residential complexes. In recent years, the high-rise construction procedure has grown dramatically in Iran [2]. A thorough and rooted examination of this issue and the problems caused by the incompatibility of this technology with the social conditions of Iranian can be investigated. In particular, due to the variety of issues related to high-rise construction, it is necessary to consider the different technical and social dimensions, despite their positive and constructive interaction, based on sustainable development indicators.

Due to its status as the first metropolis in the country, construction in Tehran has always been a center of attention. In recent years, there has been a significant increase in the construction of higher than 4-storey buildings. The growing trend of population in Tehran, together with the constraint of urban land with increasing housing demand, on one hand, and rising prices of land susceptible to urban development, on the other hand, have led to the development of high-rise construction in recent years in Tehran.

Population density in Tehran as well as its unique building density have led to the selection of this metropolis and analysis of the positive and negative effects of high-rise construction. Considering these cases and other problems facing this metropolis, the need to study and plan for issues such as environmental problems, pollution, housing issues, etc., and provision of appropriate solutions is unavoidable.

Research questions

1. What are the favorable and unfavorable effects of high-rise construction in terms of environmental quality indicators?
2. What are the social, economic, environmental and physical dimensions of the creation and development of high-rise buildings with regard to sustainable development indicators?
3. What are the factors affecting high-rise construction and its role on urban environment quality?
4. What is the relationship between environmental quality indicators and sustainable development principles in high-rise construction?

Research methodology

The present research is a qualitative study. The research method is exploratory. This survey is cross-

sectional in terms of time criterion and extensive in terms of depth criterion. In this type of research, in order to describe the case study, information is collected from the sample at a certain time period. Also, with regard to the subject under study, this research is an applied study, the results of which will be used immediately to solve problems.

High-rise buildings and urban development theory

In the second half of the eighteenth century, based on the technical, economic, and social changes brought about by the industrial revolution in Western Europe, these developments led to the emergence of contemporary urbanization in the nineteenth century, as well as the rapid expansion of cities. These fundamental changes and developments were fully consistent with the expansion of the industry [3].

Density

Population growth is such that 80% to 90% of the world's population is expected to urbanize in the early 21st century, and there are two general forms of development to accommodate the explosive population growth in cities:

- Development of existing cities
- Formation of new cities

One of the possible methods to accommodate urban population is to expand the available cities - to eliminate the disturbance and disorder that prevails in large urban communities - and to create a city or metropolitan community that is free from all the disadvantages and shortcomings of existing cities [4].

- Expanding the extended formation of cities (expanding on the horizon)
- Expanding the vertical formation of cities (extension in height).

The necessity to investigate the quality of living environment in high-rise residential complexes

The residential environment in high-rise complexes is not limited to the space inside residential units, but rather includes the spaces between the buildings and the lobbies and the corridors within them, exterior areas of the building and pedestrian access around the complex. The potential adverse consequences of the high density of these complexes makes it necessary to address the issue of quality in these residential environments, which, although not necessarily leading to a deterioration in the quality of life, specific problems

and complexities which can cause physical and social abnormalities. The aggregate of these anomalies, which manifest in the social dimension in various forms of sedition, sabotage, crime, and in the physical dimension through phenomena such as graffiti and actions such as dumping garbage in corridors, elevators, and lobbies, lead to an inclusive sense of insecurity. The living environment plays an important role in the gradual deterioration and in some cases the eventual demolition of these residential complexes [3].

Relation of high-rise buildings with urban environment

The design of high-rise buildings should have the least negative impact on the neighborhood. These negative effects include shading, visibility and privacy and the creation of wind tunnels [4]. Therefore, the height and volume of the building should be proportional to the neighborhood. The main nodes and intersections are desirable locations to place high-rise buildings [5].

Perceived quality of residential environment

A high-quality residential environment induces a sense of well-being and satisfaction for residents through physical, social or symbolic features. Such an environment guarantees the quality of life and a major support for economic, social and cultural activities. The concept of "quality of life" is strongly rooted in health consideration. In the Newman model, health is considered a viable indicator, while in other models the quality of the environment is discussed as a determinant of health. Bloom's model of health is defined as the result of genetic factors, the nature and manner of health conservation, behavior / lifestyle and quality of physical and socio-cultural environment.

Residential health and well-being are a vital component of quality of life and social sustainability. Past research has shown the adverse effects of dense population. In the case of developing countries, the effects of high density on health and well-being are far greater and more detrimental than those encountered in crowded settlements, with poorly maintained and inadequate infrastructure [6].

Two broad areas of concern related to respiratory and stressful diseases are those that arise from air pollution in high density areas (due to activity levels and number of vehicles) and mental illnesses which are often associated with overcrowding in high density neighborhoods.

The recent model presented in the area of quality of life is the Ching model which discusses different aspects of "desirable life". The basis of this model is based on four ethical theories: pleasure, dialectical insight, humanism, and formalism. According to the diagram provided by Mitchell, the elements and components of quality of life and their constituent variables include:

- Health: The overall health of any community that is the product of the physical and mental health of individuals and their members.

- Security: An understanding of security is shaped by the safe, secure environment of the individual, the economic security of the individual, and the existence of a regular and orderly life.

- Individual growth: Enjoying the opportunity to entertain, the opportunity to spend leisure time appropriately and the process of education and learning, all make the ideal achievement of individual growth and transformation possible.

- Social Development: The realization of the goal of growth and development in any society depends on factors such as the quality of citizens' political participation, social networks and social interactions, and the structure of the community in question.

Physical environment: In relation to physical environment components, attention to variables such as visual perception and landscape quality, climate, pollution and environmental noise is required [8].

In a culture with high density of life, inadequate size of living spaces affects many aspects of quality of life, which directly affect quality of life and justice, and is limited to choosing better settlement for the deprived people. Inadequate living space or crowded settlement is strongly criticized as having a negative impact on health, social relationship, privacy, and education, so per capita living space is important in assessing the quality of life and sustainability of any neighborhood. Given the relationship between density, amount of living space, and quality of life, it is important to consider the impact of neighborhood density on living space dimensions. High density settlement is often associated with the small size of a housing or garden or outdoor space. Small home size can have negative effects on quality of life. Within a culture of high-density habitation, inadequate size of living space affects many aspects of quality of life, which directly affects justice in society, and is limited to choosing better homes for the deprived. Inadequate living space or settlement density is strongly criticized as having a negative impact on

health, social relationships, privacy, and education [9], therefore, per capita is important in assessing quality of life, home satisfaction, and sustainability of any neighborhood. Considering the relationship between density, amount of living space, and quality of life, the impact of neighborhood density on living space dimension should be investigated.

Analysis of questions

1. What are the favorable and unfavorable effects of high-rise construction in terms of environmental quality indicators?

Today, high-rise buildings are the phenomena faced by that the world, especially large cities. High-rise construction causes new problems for land use due to its negative environmental impacts, including increased population density, environmental pollution, reduced access to fresh air and sunlight. But due to population growth and land scarcity, high-rise construction cannot be avoided. Therefore, for high-rise construction, consideration must be given to geographical location factors, technical regulations, immunization, green space, wind direction, distance to other buildings, design in terms of visibility and city appearance [10]. This study shows that due to changes in wind and wind direction and also the density of high-rise buildings as a source of pollution, air pollution is increased in large metropolitan areas. Therefore, to reduce the negative impacts of high-rise construction on environmental pollution, fans should be considered in the design of high-rise buildings. Unfortunately, the failure of the construction in environmental protection and the lack of control over the rules in the construction process causes environmental pollution, especially air pollution. Re-evaluating the rules, along with tighter controls, can improve the quality of air in large cities with the use of green space on the ground and on the roofs of buildings [11]. This study shows that the average concentration of carbon gas rises from the lowest levels of the building to the 2nd to 3rd floors, but gradually decreases in the upper floors through an irregular process. This is probably due to the higher wind speeds in the upper part of the building. Higher wind speeds reduce pollution severity. Although increasing altitude increases the distance from major sources of pollution (cars), the volume of pollution is not related to the distance from sources of pollution. Rather, it depends on factors such as local winds and the turbulent flow around the building, which causes pollution to accumulate in one part of the building and disperse to the other part of the building. High-rise buildings have special effects on the climate and

play an important role in the environment. Most of the changes that high-rise buildings cause to the environment are related to wind and sunlight. Adjacent complex buildings are limited by sunlight as they shade the lower floors of tall buildings as well as short buildings.

2. What are the social, economic, environmental and physical dimensions of the creation and development of high-rise buildings with regard to sustainable development indicators?

Until now, various researchers have criticized the abnormal and negative social, cultural and psychological effects of high-rise buildings. Since social, cultural and psychological impacts of living and working in high-rise residential complexes are of great importance, and social interactions and psychological impacts are much wider, this has led to criticism of high-rise construction in residential buildings. In fact, the study of residential buildings is important because housing has an important place in socio-cultural and psychological categories, such that housing is the most important provider of civilization and home is the best preserver of social culture. Housing is one of the key factors in the balance and sustainability of the human community and protects the family and relationship between its members. That is why adequate housing, like other human needs, is a basic human right. Lack of attention to the role of housing in urban family social relations, without any doubt, makes it impossible to enjoy high social behaviors and high human values [12]. In the past, all residents of a neighborhood in Iran were interested in the surrounding issues and there was some degree of coherence and relative social control. While the social, cultural, economic and political developments of society in recent decades have been replaced with some kind of indifference, lack of housing and inadequate quality and lack of attention to its role in social relationships are associated with increased rates of delinquency, divorce and social breakdown. Therefore, paying attention to the importance and role of housing from social dimensions is effective in the cultural and psychological development of society [14]. This is especially important when living at high altitudes causes a change in the human environment, followed by a change in living culture. Therefore, the construction of high-rise buildings, regardless of the cultural issues of the community, cannot be a suitable solution to the housing problem. Although residential areas have witnessed the introduction and expansion of foreign and mostly western patterns and methods over the past century, it seems necessary to recognize the

problems created and find solutions to co-ordinate high-rise buildings specific to Iranian society in order to improve and promote living conditions [14]. Therefore, to understand the social, cultural and psychological aspects of high-rise buildings, the impacts of these buildings on residents should be examined in the following areas to determine the amount of increase in density and capacity of high-rise construction in residential areas:

Residential high-rise construction and neighborhood relations

Residential high-rise construction and family commuting

Residential high-rise construction, ethical and educational issues

Residential high-rise construction & Mental Issues

Residential high-rise construction & Security

Residential high-rise construction and social classes and groups

Residential high-rise construction and property

Residential high-rise construction & Partnership

Residential high-rise construction and indigenous identity [15]

In general, what follows is that apartment life is not suitable for all social groups and classes. Of course, the issue needs to be scrutinized more carefully, but overall, it can be concluded that high-rise living is more suitable for middle-class people than poor urban strata who often have a rural culture. Also, in a high-rise building, due to very close proximity, if residents have also a similar culture, better relationships and greater resident satisfaction will be formed.

3. What are the factors affecting high-rise construction and its role on urban environment quality?

Irregular development at the urban level is one of the dangers that always threaten the sustainability of the environment and consequently the sustainability of buildings. The low population density of a city that is generally inconsistent with the requirements of a sustainable city is usually formed in the suburbs and has been challenged and criticized by social and environmental sustainability experts [16]. High-rise construction can be considered as an approach to prevent this problem. In other words, the pattern of the city leads to functionalism by high-rise construction, and the optimal use of land becomes feasible from this perspective. Beyond social benefits, the dense urban pattern can also have important environmental benefits. Concentrated cities can be designed through a coherent and

integrated planning to optimize energy consumption and reduce resource consumption as well as reduce environmental pollution and prevent reaching rural areas around cities [17]. Some of the undesirable consequences of large and low-density cities in terms of sustainability can be described as follows:

□ Consumption of large amounts of high-quality agricultural land for housing and roads;

□ Increase of constructed lands resulting in increased surface water flow, gasoline consumption and other wastes;

□ Increase of energy consumption and pollution by reducing the use of public transport, pedestrianism and cycling;

□ Increase of energy consumption in open and single-family residential units through their lower design efficiency than compact housing forms

4. What is the relationship between environmental quality indicators and sustainable development principles in high-rise construction?

In sustainable urban development, the quality of human life is centered on urban space, so that the continuity of citizens' lives is enhanced by social prosperity and does not harm the sustainability of the urban environment. Attention to communication is the strength of sustainable development theory which can lead to sustained development [18].

There are many physical factors involved in moving to a sustainable city. However, mere physical changes without the backing of economic and ecological developments will not sustain cities. For a closer look, in this study, the impacts of building density factor on the level of human needs and environmental quality in high-rise buildings were specifically investigated. Since building density does not necessarily affect all aspects of human needs and all aspects of urban quality of life, only the indicators of urban quality of life where emphasized that vary with urban density variations in general and building congestion in particular.

CONCLUSION

The need for a high-rise construction strategy is increasingly apparent, given the growing population and land constraints in the present. High-rise buildings, being the product of technological advancement, can cause various environmental contaminations and abnormalities, including visual disturbances, if they are not adequately controlled and monitored, due to adverse environmental impacts associated with high population and building densities. Issues such as increased rentals

in the area, lack of coordination and balance between available density and infrastructure capacity, inadequate ride and pedestrian access, inadequate transportation, traffic, lack of urban parking and noise pollution and visual effects complications due to unmanageable density and overcrowding of high rise buildings, especially in residential areas, can play a role as specific environmental signs and characteristics in conflict with the real needs of the people in their value hierarchy, resulting in a sense of inability to control the living space and therefore lack of a comfortable, relaxed and satisfying experience in urban life. It can be stated that high-rise buildings can meet the needs of the community when they are built based on feasibility studies and scientific, technical, and management design, and in accordance with the advanced technologies required for such buildings, such that all the high-rise construction criteria and principles are met.

Competing interests

The author declares that they have no competing interests.

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ARCHITECTURAL SOLUTIONS TO REDUCE THE EFFECTS OF SALT STORMS

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ABSTRACT: With an increased level of salty and saline land in the region around Lake Urmia followed by powerful winds and the creation of salt dust, the agricultural lands of the region progressively move towards salinization and eventually desertification. Environmental adverse effects of salt dust in the dried areas of the lake, which is the chief source of this problem, can be minimized by drainage. In more detail, by continual or sporadic flooding methods or by sprinkler irrigation and precipitation, soluble salts can be washed from saline soil profiles. Object-oriented image analysis (OBIA) techniques are one of the latest means of satellite image processing in the scope of remote sensing. These techniques have significant potential in soil science studies. The application of soil improvers to advance the physical and structural characteristics of the soil is quite common. This study is of review and descriptive type, and the collection of resources in this study was a library method and by reviewing Internet resources. The results of this research suggest relevant architectural and urban design solutions to reduce physical vulnerability to storms. In this respect, solutions have been given.

KEYWORDS: Salt Storm, Architectural Solutions, Soil Improvers, Climate

INTRODUCTION

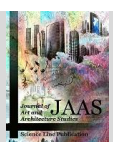
Natural and synthetic processes are currently critical threats to aquatic ecosystems and objects. Mainly due to mismanagement of water use in the basin and reduced access to the lake, Lake Urmia, the world's second-largest salt lake in northwestern Iran, is drying up. The lake's water level has been declining rapidly since the mid-1990s. Meanwhile, the construction of fifty dams and diversion structures driving climate change, are the principal reasons for this. The creation of a 15-kilometer road in the middle of the lake's Street is another reason that stops the normal circulation in the lake. The situation has become severe over the past two decades, and the need for restoration is an essential priority for the region. The contribution of ten main rivers to pour into the lake is considered as the ultimate solution to this disaster. However, the biggest challenge associated with any restoration program is public awareness and information about environmental values. Environmental adverse effects of salt dust in the dried areas of the lake, which is the chief source of this problem, can be minimized by drainage. Hitherto, drainage has only meant discharging excess water from the ground. Obviously, this has been done in dry and semi-arid regions, along with the extraction of excess salt from the soil. Salinity and wetlands are related phenomena.

Near the year, phenomena influence the movement of water in the soil and are a function of factors such as climatic conditions and soil characteristics [1]. Optimization of saline soils usually starts with the downward displacement of accrued salts on the surface, and the restoration of these soils by interruption of capillary ascent flow has also been studied [2].

In developed countries, due to the attention of these countries to environmental protection and the existence of governmental and non-governmental institutions, the destructive effects of human activities and environmental degradation are low and limited. These environmental harms and damages happen in different manners in different environments such as seas and lakes, jungles, cities, villages, and other spaces. Meantime, the elimination of water resources (sea, lake, swamp, river, spring, etc.) due to the direct dependence of human life on them and the preparation of human water needs, are of supreme importance. Wetlands are worthy ecosystems that have a broad variety of functions among many types of natural ecosystems. In addition to protecting biodiversity, they further have multiple other natural, economic, and social values. Economic researches prove that a wetland has about ten times the economic value of forests and 200 times the economic value of arable lands [3].

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Lake Urmia and its environment

It is the twentieth largest lake in the world and the second after the Dead Sea in terms of salinity. Its maximum depth is 16 meters, and its average depth is 5 meters. The average length of this lake is about 140 km, and its width is between 16 and 63 km. Also, its approximate volume is estimated at 31 billion cubic meters. The water of this lake is chiefly fed by 14 permanent rivers including Zarrinehrood (41%), Siminehrood (11%), Godar (8%), Barandooz (6%), Shahrchai (2%), Nazlouchai (6%), plus 7 seasonal rivers, 39 flood streams, springs within the lake, and direct rain and snow. The lake was registered on the UNESCO World Heritage List (1967). It is also registered as one of the international wetlands (registered in the Ramsar Convention) [4].



Figure 1. Urmia Lake

Urmia Lake is one of the most important international wetlands that has come to the brink of elimination in recent years for many factors, including the implementation of development projects. The adverse situation of Lake Urmia began a decade ago and is getting more critical day by day. Insofar as with this current trend, the possibility of total drying in the Urmia Lake in the following few years is not far from expectation. Lake Urmia's basin has been suffering droughts and consecutive dryness for at least a decade. Also, this basin is located in the construction place of different water structures in the form of dams, dikes, and bridges. These dams have been built without consideration of the copious droughts and lakes. This has led to the expansion of agriculture in the upper reaches of the rivers. Because of natural and man-made factors, this upstream prosperity has born the gradual drying up of the lake. The consequences of this problem in the succeeding few years will display in the form of disturbance of biological foundations in the area, urban and rural settlements, salinity of agricultural soils, and the emergence of one of the dust centers in the northwest of the country [5].

Considering the high biodiversity and the presence of different habitats in this basin, it can be assumed that this area is one of the most significant

and affluent biological parts and natural ecosystems of the country. For this reason, the obligation to preserve natural habitats, not only in officially protected ranges but in the entire natural environment of Lake Urmia, which entails sensitive and vulnerable ecosystems, seems inevitable. These ecosystems are quite fragile and vulnerable to natural and synthetic changes. That is why making any environmental disturbance without factoring in the special features in them, will have a destructive and adverse result. If the ecological balance is upset, the reproducibility is very restricted, and it is quite challenging to return them to their original state. In terms of salinity, this lake has unique ecological and climatic conditions for the settlement of specific plant and animal species. Insofar as the development of valuable habitats in this area has improved biodiversity. Environmental standards, such as excess consumption of freshwater for agriculture in the coastal spaces around the lake, contamination of water and soil resources by many industrial pollutants, agriculture and urban wastewater and construction of a passageway in the lake, without evaluating the adverse environmental results, have altered the hydrological and hydrodynamic processes of Lake Urmia. The results confirm that if this trend remains without optimal environmental management, we will shortly observe the disappearance of ecological, economic, tourism, social, and aesthetic indicators of the lake. This is currently befalling with drought and human intrusion on the natural environment of the lake. Additionally, as a result of the interaction of increasing lake water salinity and overfishing, a large part of *Artemia* crustacean has been lost. These results are a serious alarm for the failure of maintenance management and unsustainable exploitation of worthy natural ecosystems of Lake Urmia.

Population distribution of human societies and the development of polluting sources

According to examinations conducted in 2007, the human population in the Lake Urmia basin was approximately 4913553 people. Of these, 69% lived in urban regions, and the remaining 31% dwelled in rural spaces. The higher urban population statistics show the huge capacity for changes in the ecosystem of the region by human and manufacturing factors. Because the quantity of pollutants in urban areas is more than in rural ones. Parallel with the event of drought, rapid, and uncontrolled population increase in arid and semi-arid zones is likewise one

of the critical obstacles to achieving sustainable development. The impact of this factor on water resources management is also quite grave and alarming. Because on the one hand, it raises water consumption and water supply services and, on the other hand, because of increasing the volume of domestic and municipal wastewater and industrial process effluents and agricultural drainage water, it generates many problems and issues in managing environmental quality and especially sustainable management of water and soil resources [6].

Pollution from port activities

Other significant sources of pollution in Lake Urmia is port activities. There are major ports in Lake Urmia, the most important of which include the Sharafkhaneh port in Shabestar city, Golmankhaneh port on the west coast of Urmia (20 km from Urmia city), Rahmanloo port in Maragheh city, and Aq Gonbad port in Eslamy Island. Different activities in ports contaminate the water of Lake Urmia.

The impact of salt dust and its environmental results

The drought of Lake Urmia causes the precipitation of salt sediments and the rise of a suitable bed for the creation of dangerous fine dust during harsh storms. Considering that the direction of the prevailing winds in the region is in the direction of southwest, west, and southeast, the possibility of political-security damage to the coastal cities of the eastern to northeastern and even northwestern shores of Lake Urmia due to salt storms is very high. Field studies and conversations with the natives dwelling in the Gorchin Qaleh and Qal Qachi regions indicate the existence of this destructive phenomenon. Lake Urmia is the second most salt-saturated lake in the world. Supersaturated solutions are sensitive to the slightest changes. These solutions are converted to saturated solutions with the slightest change in conditions and precipitate huge quantities of solutes. This law of chemistry, with the least change in conditions, causes the deposition of various salts (gypsum and anhydrite - halite and Sylvite, Carnallite, etc.). This causes the precipitation of salt sediments in the lake bed. This phenomenon (salt precipitation) decreases the volume of the lake and regresses the waterline of the lake. Meanwhile, with this regression, saline areas with a deep salt layer (salt precipitation) expand. Based on the crystallographic system and mineralogical system,

As the salt dries when exposed to air at a pressure below the unit stability limit, the salt breaks down into a powder and disperses rapidly into the encompassing areas. The expanse of salt along with water, wind and other dispersing agents, on the one hand, causes the development of saline areas, and on the other hand, with the impact of salt on vegetation, animals and even humans, cause the loss and reduction of living conditions in the area. The expanse of the salt desert happens at a very high rate, and its influence on soil and the climate is much more critical than the impact of deserts in central Iran. The expansion of the salt desert by the salt storm resulting from the constant drying of Lake Urmia has the potential to destroy 1,200 square kilometers. Due to the crystallographic lattice and salty cleavage, this mineral is very easy to crush and powder. Following leaving the water, salt deposits are exposed to erosion and are moved as particles with the wind. Therefore, with the wind blowing, a salt storm forms in the area and affects a very broad area (around 1200 km) in the shortest time. This transfer is reported to improve and expand the salt desert, hence destroying the biological system.

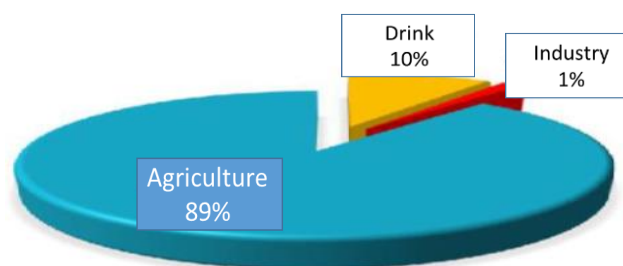


Figure 2. The volume of water consumption in various parts of Lake Urmia basin (<http://ulrp.sharif.ir>)

Climate

Surely, one of the most critical concerns following the regression and drought of a large part of Lake Urmia is becoming one of the active centers of salt dust in the area. The irreversible consequences of this matter will appear in the not too distant future. The figure displays areas of the country within a radius of 75 km, 100 km, and 500 km from the lake. Regrettably, if this lake becomes one of the active centers of dust production, a notable population will be exposed to the menace of dust created by the drought of Lake Urmia [7]. Desertification is additionally one of the most critical dangers caused by the regression of a notable area of Lake Urmia. In fact, the hurtful experience of Lake Aral proves that the transformation of Lake Urmia into the desert of Urmia cannot be far from the expectation.

Winds

Winds are one of the climatic factors whose direction, amount, and intensity are effective in climate change and precipitation. The maximum mentioned frequency of wind in Urmia station is 30%, blowing from the west. Insofar as the west wind can be considered the dominant wind in the area. Winds blowing from the northeast, north, and southeast are in the next places in terms of wind frequency with 13.6, 13, and 10.7%, respectively. Rainfall is normally concentrated in the months when westerly winds are prevailing. In spring, the intensity and span of winds are higher. Next, in summer, autumn, and winter, and eventually in spring, a relative balance is set between the east and west winds. Lake Urmia additionally helps to relocate surface masses by creating several breezes during the day and night. Particularly in mild and

warm seasons, the impact of the lake in creating a breeze is more prominent. In fall, the direction of this relocation is east-west, while in winter, the wind blowing from the west is quite striking. In general, the main direction of the wind is from the west.

The local winds that blow in the Urmia area are as follows:

- Salmas winds: This wind blows in a north-south direction and in Urmia, it is known as Salmas (north) wind.
- White and black winds: blows in the opposite direction of the north-south wind and is known locally as "Aq Yel" (white wind).
- Land-sea breeze: This wind is sensible owing to the pressure difference between land and lake, and during the day, its direction is from the lake to land, while at night, it is from land to sea (<http://tarrahi.blogfa.com/post/60>).

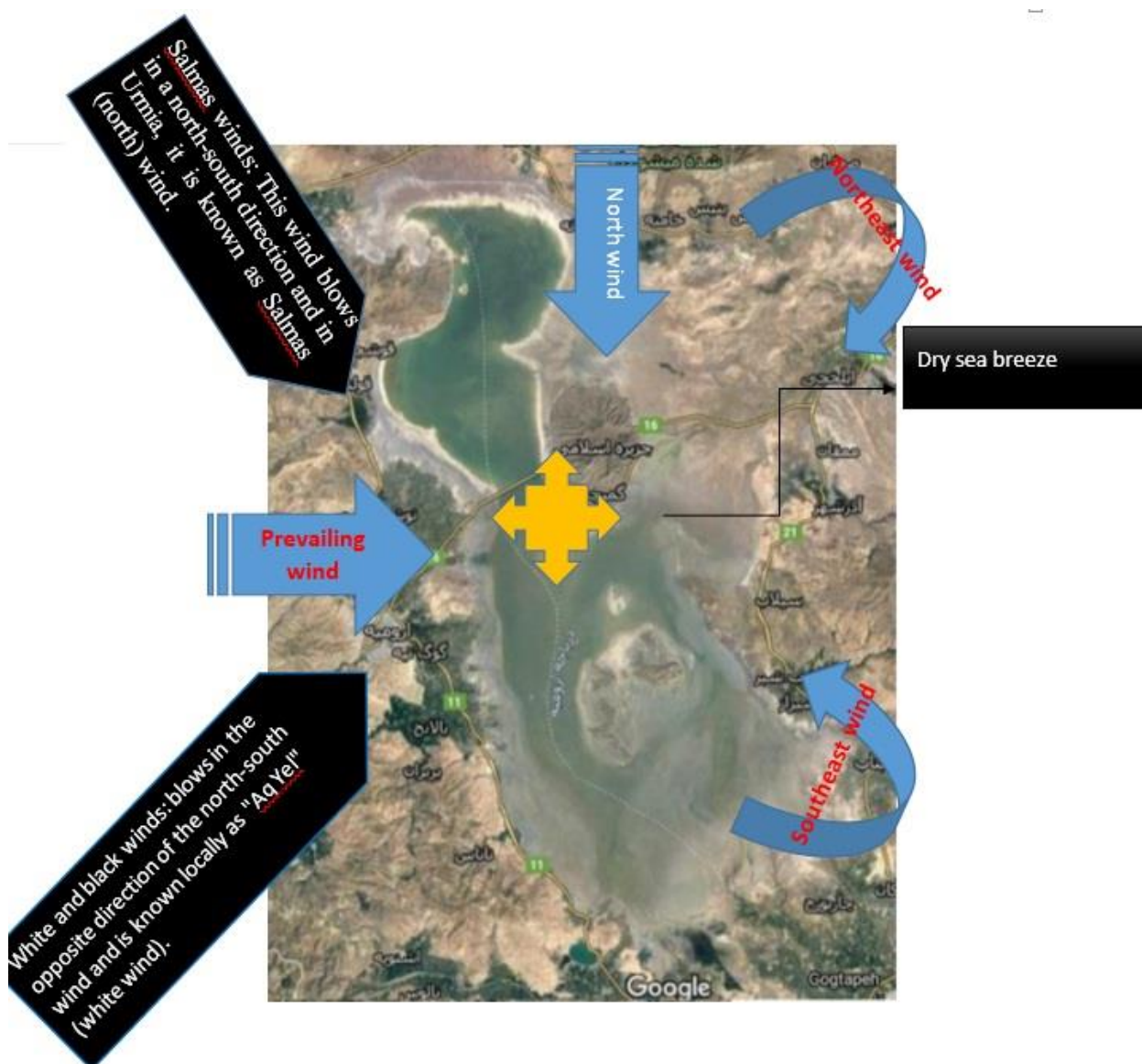


Figure 3.

Climate indicators

Solar Index. is a coefficient based on which the amount of building use of solar radiant energy is defined (National Building Regulations of Iran, Article 19).

The effect of wind on the feeling of comfort. In general, wind can affect human comfort in open urban spaces in two chief ways. First, through the physical impacts it has on human activities and is made by wind pressure on the human body; And second, through the influence on the temperature sensed by the human body.

Beaufort Index. The wind changes the feeling of comfort by applying pressure and force to humans and things in the open air. In this case, the higher the wind velocity, the greater the pressure on humans and things. Thus, its effects on people's comfort will be different. In different countries, there are huge differences between the criteria used to estimate the tolerance threshold.

Penn Warden Index. examines the relationship between human thermal comfort and atmospheric factors such as wind, temperature, and radiation, along with human factors such as clothing and activity. Suitable and unsuitable winds of an area can be identified based on meteorological information of the area [7].

The foremost reasons for the drying up of Lake Urmia

The causes and outcomes of the destruction or drying up of lakes, which are mainly caused by human interference or natural elements, in many parts of the world are different. These consequences include economic, climatic, environmental, and recreational instability. Adverse consequences of this happening include population perils, biodiversity loss, illness spread, habitat loss, climate change, plant and animal population decline, and the like [8].

- 1- Absence of coherent planning program for the entire basin of Lake Urmia
- 2- Abnormal dam construction
- 3- Shahid Kalantari freeway in Urmia Lake

Political-security outcomes of drying of Lake Urmia

Library findings

Salt storm threat. According to the researches of Urmia Lake Revive Headquarters, the dryness of the lake engenders the precipitation of salt sediments and the formation of a suitable bed for the formation of hazardous dust during harsh

storms. Owing to the prevailing winds in the region, which are in the southwest-west-southeast direction, the probability of harm to the coastal cities of the eastern to northeastern and even northwestern banks of Lake Urmia due to salt storms is quite high. The phenomenon of salt storms will further induce the destruction of agricultural lands and the incidence of diseases like asthma, cancer, etc.

Poverty and unemployment. Since the villagers are poorer and also do not have the required knowledge to deal with the threats due to lack of literacy, their vulnerability is higher. When confronting the crises, it is essential to be prepared and respond properly. In this regard, recognizing the current situation, identifying hazards, assessing risks, determining vulnerability, and intervening to lessen harm to communities is necessary. Because otherwise, the destruction caused by the disaster will increase promptly in the short term. According to the FAO, with the drying up of Lake Chad, fishing decreased acutely, and as climate change and its disastrous effects on agriculture in the region grew poverty and the spread of many diseases, people in the region were forced to move to other regions. It has also been determined based on comparative studies that the drop in the level of the Aral Sea has led to the elimination of fishing-related activities, and the drying up and abandonment of the ports of Moynaq in Uzbekistan and Aralsk in Kazakhstan. Further, the fishing industry in these two ports was demolished along with 60,000 jobs, incurring irreversible economic and social costs. Lowered economic activities in the region will raise unemployment, reduce the livelihood of indigenous peoples, and thus increase poverty.

Migration. Soleimani Ziveh [9]'s study in 2010 reveals that the drying of Lake Urmia induces the destruction of thousands of hectares of agricultural land in the region of this lake. The least consequence of this is the unemployment and migration of almost 3 million people in the provinces of East and West Azerbaijan.

Closing of conversion industries. A different study by Hesami and Amini [10] in 2016 explains that with the destruction of agricultural lands in the Urmia Lake basin, which happened due to the drying of deep wells in agricultural lands, the closure of 34 conversion factories in West Azerbaijan province alone will have irreversible effects in all areas of economic, industrial, social, and cultural, and will result in the forced emigration of villagers and marginalization around cities.

Tourism: Numerous studies have been conducted about the impact of drying of Lake Urmia on tourism in this area, which indicates that the tourism situation is worsening with the drying of Lake Urmia. Asghari Sar-Eskalrood with the cooperation of other researchers in 2014 [10] claimed that in addition to the natural environment, the drying of Lake Urmia influences the economic and social environment of the region. Insofar as in recent years, the continuation of the upward trend of lake water depletion induces the destruction of resorts, recreational and household complexes, destruction of coastal infrastructure, unemployment of local citizens and migration of inhabitants of villages along the lake, reducing tourist arrivals, reducing income from the tourism industry and ultimately demand pressure on nearby destinations. With the regression of the water of Lake Urmia,

investing in the tourism for this lake has faced difficulties, and the construction of seaside tourism facilities in this domain no longer makes sense.

Prevalence of different diseases:

Comparative studies directed on dried lakes in the world and studies by researchers and Lake Urmia Rehabilitation Headquarters show that the spread of various illnesses in this area is probable with the drying up of Lake Urmia. Diseases include increased neonatal mortality, low birth weight, late pubescence, anemia, respiratory illnesses, immune system deterioration, neurological and behavioral changes, and infectious diseases. These investigations also prove the emergence of social anomalies, public distrust of government performance, difficulties in managing the regional space, and ethnic, tribal, and marginalization conflicts.

Table 1. Classification of influential variables based on experts' opinions

Index	Classification of the variables
Economic issues	Regional economy, regional employment, regional tourism
Production area	Agriculture of the region (agriculture and horticulture), industry of the region, livestock and poultry breeding of the region, livestock and dairy products of the region, honey production in the region, health of poultry and livestock of the region, emergence of new uses, salt harvesting needed by industries
Political issues	Political crises
Natural issues	Agricultural soils, rangelands, salt storms, dust, quick sands, saline and non-saline dust centers, water resources in and around the area (wells, springs, etc.), sunlight reflection (albedo), light radiation, radiation from salts and elements, local climate, the dominant ecosystem of the lake intrusion area, the ability of the area to become a national park
Social issues	Health of local residents (physical, mental), local people, farmers community
Residential system	Migration (village to city, out of province, etc.) Ruralization
Major issues	Toxic compounds, food chain

Source: Research Findings (2017)

The effectiveness of Gum Arabic and Use of Object-Oriented Fuzzy Technique in Improving Physico-Chemical Conditions of Saline Soils

The use of soil improvers to improve the physical and structural characteristics of the soil is quite common. Gum Arabic improves soil's biological properties even in saline soils. Such that it increases the soil respiration from -67 to 275 (1-day CO₂kg 2CO) in treated soils when the original respiration was 7 to 77 (MgCO₂KG-1DAY-1). Gum arabic also developed the hydraulic conductivity of the saturated soils and decreased the acidity of the test soils. Soil salinity, as one of the global and critical perils in arid and semi-arid zones [4], is one

of the most influential and effective factors on soil quality while it has no instantaneous and rapid effect [11]. According to researchers, soil salinity has been suggested as an abnormal environmental hazard due to its effects on human life [12].

But this working solution is limited because of the low quality of saline soils. Hence, other strategies to increase soil quality are needed to better establish vegetation. In applied agriculture, there are soil modifiers that improve soil physical condition by being added to the soil. Such substances are termed soil improvers. These materials can be synthesized or natural, organic, or inorganic. Other than enhancing the physical condition of the soil, natural polymers also add much nutritional value to the soil.

Since they are natural, these materials can be more affordable than synthesized polymers [13]. Arabic gum, or acacia gum, is a hydrocolloid that produces a gelling property in the presence of water. It is a high molecular weight polysaccharide branched chain with calcium, magnesium, and potassium salts. This substance may be neutral or slightly acidic with a pH of 4.5-5.5 [13]. Because of the presence of hydroxyl groups in the gum and its hydrophilicity, it can condense viscosity or form a gelling or gel-like state in the environment it is present in [14].

Object-Oriented Image Analysis (OBIA) techniques are one of the new techniques of satellite image processing in the domain of remote sensing with significant potential in soil science investigations. In this respect, OBIA is recognized as a method that mixes the spectral and spatial pattern of satellite images to produce more accurate results. This method has been developed against basic pixel methods, which face a severe challenge of spectral property similarity. The chief objective of this research is to investigate soil salinity and apply a unified approach of object-oriented fuzzy to control land cover changes in the eastern bank of Lake Urmia, which has been influenced by salinity expansion.

Control of salt dust particles by the non-biological method and by blending them with lime and clay

Chlorides are prevalent in marginal areas. Because these substances are mainly of aquatic origin and are absorbed in large amounts of water. There are two main methods of penetration of these salts. One is through the ground and with the help of upward moisture in the walls. The other is through unwanted marine materials that are transported by the wind as a spray from the sea.

How to prevent this problem from occurring?

The first way is to use salt-free sand and cement and to use stones in a dry and mechanical manner. That is, to pin and screw the stone to the building surface. **The second method** is to use washed sand with less salt. Some cities in Iran have sweet soil. In fact, no matter how deep we dig, we will yet reach sweet soil. These types of soils contain the best sand and cement for facade construction. After working on your building stone, wash it twice with urban water at intervals of 7 to 15 days.

How to remove dandruff from stones and bricks

- Abrasion of the surface
- Hydrochloric acid
- Washing with water and brush
- Nano stone



Figure 4. Dandruff formation and its mixture with lime and clay



Figure 5. How to remove dandruff from stones and bricks

Introducing risk

Tornado and Tropical Storms

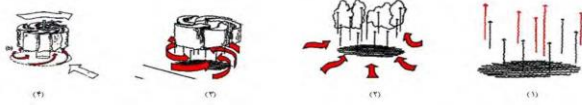


Figure 6. Stages of formation of tropical storms

The effect of salt storms on buildings

A tornado brings different destructions depending on its velocity. How powerful winds influence buildings depends on four factors: the

situation of the building, the height and shape of the construction, and the location of the building relative to adjacent buildings. The wind force is essentially dynamic, but for simpler representation, it is used statically. Wind power distribution in buildings is in the form of steps and is always vertical to the surface [15].

The impact of wind on the body of the structure

The overall effects of wind on buildings are as follows:

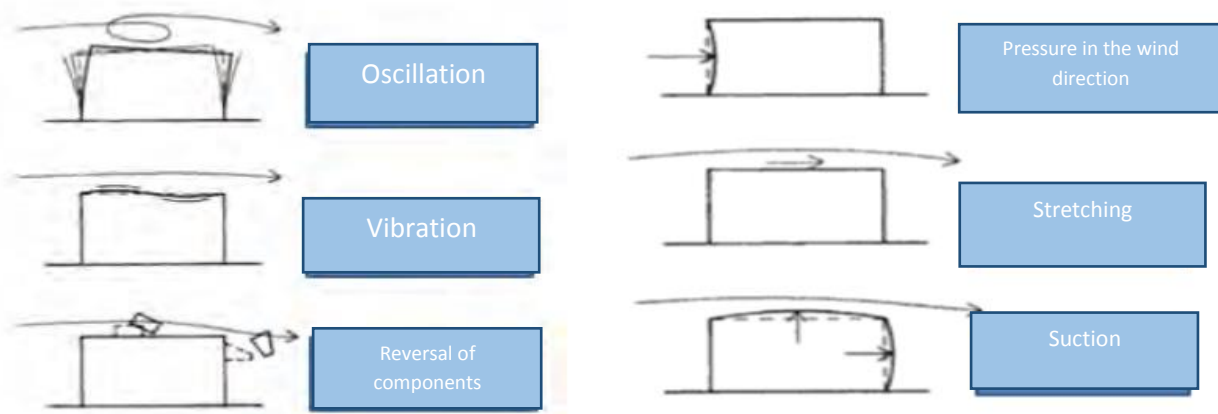


Figure 7. Effect of wind on the building

The effect of wind on the outer aspects of the structure

Other than the pressure they exert on the side exposed to the wind, the winds create suction on the opposite side and upward force on the roofs (<https://www.ready.gov/tornadoes>).

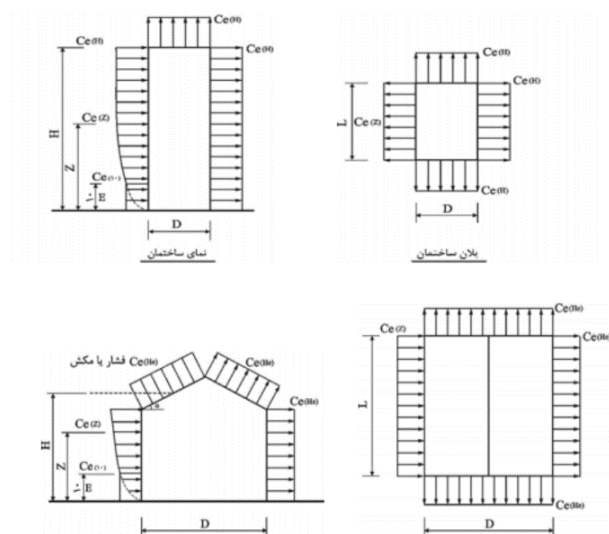


Figure 8. The effect of wind on the external walls of the building

Wind-resistant building systems

Domes, arches, and most shell forms are types of wind-resistant systems. Stabilizing the form against the wind starts with building a big base against overturning. The Transamerica building in San Francisco is an instance of this. Another issue is the ratio between the height of the building and its minimum size at the base, known as the slenderness factor. There is also a difference between the Slenderness ratio of the building mass and the effective slenderness factor, which is obtained from the effective structural lateral support mechanism. Modern high buildings add to the constraints of this slenderness factor. In such tall structures, lateral loads are more important than gravity ones.

The presence of rigid joints, shear walls, and braced frames further increase the resistance of buildings to lateral forces, like the wind. In addition to the lateral support, regardless of its type, the bracing tends to move from the center of the floor plan to the outside of the building to obtain more stability in the structural system when lateral loads increase. This practice can be completely seen in the John Hancock building in Chicago [16].

Tornadoes are a serious menace to buildings and inhabitants in many places. The building may be "properly built according to the rules," but that does not mean it can be protected from harsh events such as tornadoes and hurricanes. The answer is a safe room or shelter from the wind. Places, where a safe room can be built, are the basement, on top of a slab, or a concrete garage, or an interior room on the first floor.

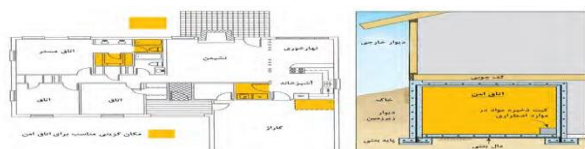


Figure 9. The correct location for the safe room

A safe room built in the basement gives maximum protection. But a safe room made in an interior room on the first floor cannot be as secure. In the basement, the safe room should be designed to limit water from accumulating through heavy rains. To build a safe room, the following points should be minded.

- Enough size to confront overturning
- Resistance to wind pressure and the penetration of objects in walls, ceilings, and doors
- Solid connection between all parts of the room for wind resistance
- Safe room walls should be able to be detached from the accommodation structure so that damage to the accommodation does not harm the safe room [17].

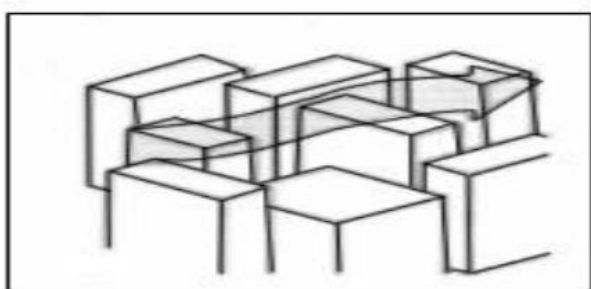


Figure 10. How the building is located

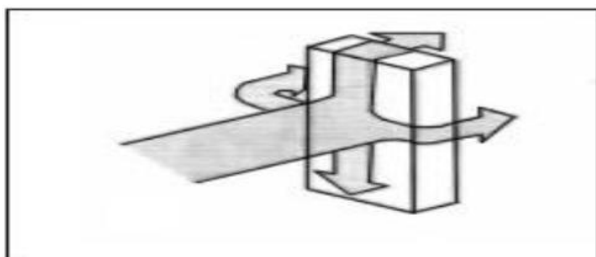


Figure 11. Better deployment

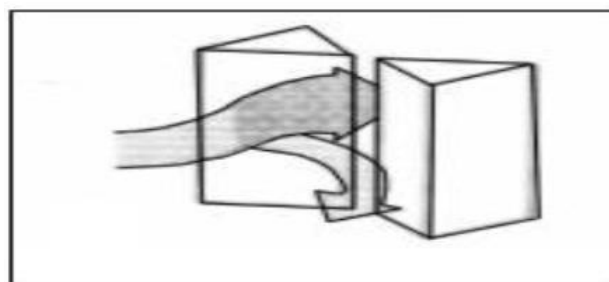


Figure 12. Influence of wind affected by the shape of the building

In spaces where, for reasons such as severe cold or heat or extreme dust, the building should be protected from very cold or very hot winds, building complexes must be designed to be compact to block the wind. In cases where high-rise buildings are created near the streets, the highest and shortest points of the building on the windward front should be in the same direction so that the airflow reaches the street level.



Figure 13. The highest and shortest points of the building on the windward front should be in the same direction so that the airflow reaches the street level.

Site design solutions against salt storms

It is not always possible to create outside the tidal zone. If a house or structure is in the vicinity of a tidal wave, methods to reduce tidal and hurricane damage should be considered. The best means to protect property is to build at a level higher than tidal levels. Ideally, all worthy property should be secured at a level above the height of the storm tide. To this end, one can use the slopes and heights on the site and build constructions on the hills or behind them (Figure 14).

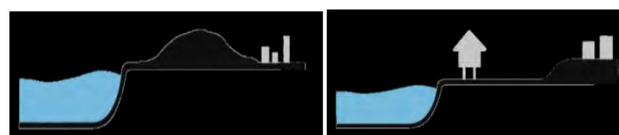


Figure 14. Building the structures on a higher level, on hills and heights, and behind the hills
About the adjacent buildings, cluster and non-row layout are favored over row layout to block wind tunnels (Figure 15).

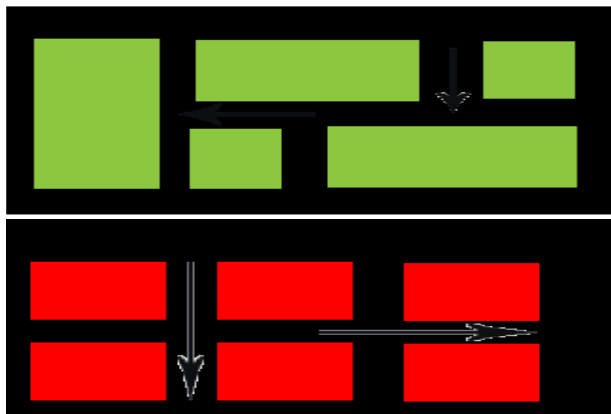


Figure 15. Avoiding wind tunnels in the cluster plan

Planting rows of trees at a distance of 8 to 10 times their height difference with buildings is another approach to decrease the risk. Minding this distance is very critical (Figure 15).

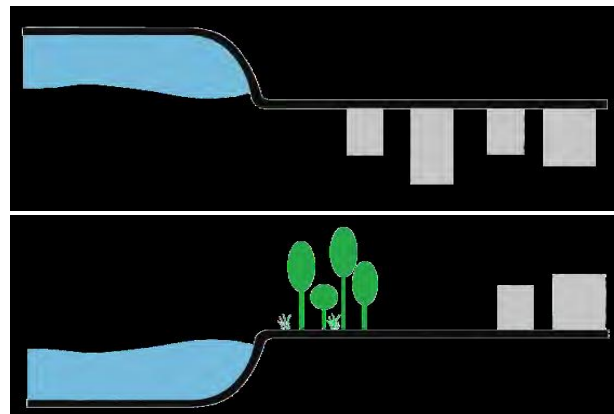


Figure 16. Planting rows of trees to guard constructions

Elements like fences, cottages, and tiny warehouses and water tanks should be set at standard distances on the site, as harsh salt storms can maximize the possibility of damaging adjacent buildings (Figure 17).

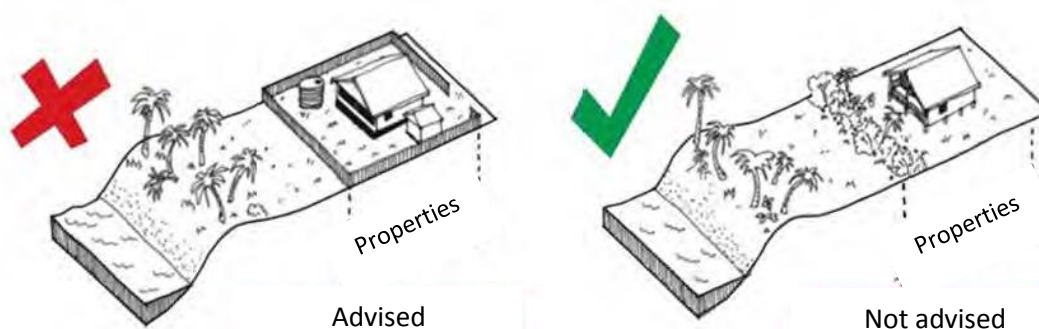


Figure 17. Avoiding the placement of site elements at non-standard distances from the building

CONCLUSION

In this study, while examining the effective factors in the decreased water level of Urmia Lake, soil salinity, environmental and ecosystem outcomes of the decrease of water in this lake were studied. excessive human interventions in the ecological cycle of the area, such as digging many wells, constructing many dams without detailed investigations, constructing the Shahid Kalantari bridge, etc., have played a notable part in causing this poor situation for Lake Urmia. The results of the research show that with the continuation of this course, the environmental and health hazards of Lake Urmia in the not too far future will change the region and encircling cities and provinces. As a result, this great

national blessing will become an irreversible environmental catastrophe. With the salinities built around Lake Urmia, salt particles exposed to the air can be moved by the wind and precipitate on fertile lands. As a result, agricultural lands become unusable. Furthermore, the movement of these salts by wind and their precipitation in surface water and infiltration into groundwater yields the salinization of irrigation water. Salinity is one of the harshest environmental constraints on agricultural productivity. The use of Gum Arabic, as well as object-oriented image analysis (OBIA) techniques, is one of the latest techniques of satellite image processing in the field of remote sensing. This method, which has significant potential in soil science studies, is advised as a solution. Considering

the answers to deal with soil salinity, building design solutions, and confronting salt storms, we concluded that buildings with a circular form have less resistance to wind and pass it easily. In areas subject to harsh storms, the number and strength of glass doors and windows should be ensured. Because these parts are quite weak and are one of the most critical factors in the storm to enter the house. Since different roofs also exhibit different resistance to storms, care must be taken in picking them. Still, every house needs a safe room that people in the home can cover in the case of an emergency. These shelters can be made in the basement, above the garage, or in a room on the first floor. Additionally, constructing houses behind natural barriers such as hills in a cluster organization, and planting trees at a proper distance around them are some of the measures that should be considered. To deal with the impacts of salt storms, designs such as dynamic capacities, fencing, etc. have been introduced that can be employed according to the studied bed.

DECLARATIONS

Authors' contribution

All the authors contributed equally to the work presented.

Competing interests

The authors declare that there is no competing interests.

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SICK BUILDING SYNDROME: NATURAL DAYLIGHT CASE STUDY

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ABSTRACT: In the taxonomy of creatures, human is a complex being, a feature that makes him vulnerable, such that if he lacked the power to reason and intelligence, he would certainly not be able to deal with the threats of the nature. Creating a shelter, from its primitive form for cave dwellers to today's luxurious buildings, all point to the man's need for privacy that primarily guarantees his security, but a closer look at this physical boundary between man and nature, which is known as residence, reveals that there are a plethora of problems, questions, and requirements besides security, ranging from the extent to which nature suffers as a result of construction to the health problems that this demarcation creates for humans. Evidently, not being attentive to the environment will result in health problems, but since sustainable architecture is not necessarily considered a moral obligation to care for the health of residents, developing building regulations and design policies with an emphasis on human health seems essential. One of such problems, whose consequences are clearly noticeable in current societies and families, is the lack of access to natural daylight as a result of increased unorganized constructions and regardless of environmental conditions, and ultimately the emergence of dysfunctional buildings for their residents in the community, which in turn will eventually bring about irreversible physical and mental problems. In this article, the notion of "Sick Building Syndrome" (or SBS for short), and its underlying causes are reviewed by conducting a series of studies on authoritative and up-to-date sources, articles, and books. Here, the role that natural daylight plays as one of the major elements whose lack or absence will lead to the formation of a sick building in society, along with the factors and elements contributing the increased prevalence of this type of building are studied in the scope of architectural designing. The authors believe that identifying the reasons for the rise of acute health problems in our current society and promoting builders and architects to use appropriate and low-cost solutions, will greatly alleviate these problems.

KEYWORDS: Sick Building Syndrome, SBS, Daylight, Architecture & Health, Architectural Design

INTRODUCTION

The term "syndrome" is derived from the Greek language, essentially meaning concurrence, while today, it mostly refers to a group of symptoms which consistently occur together [1].

Sick Building Syndrome (SBS) was recognized as a medical condition by the World Health Organization in 1982. The World Health Organization defines SBS as a group of nonspecific symptoms including symptoms such as eye, nose and throat irritation, mental fatigue, headache, nausea, dizziness and skin irritations among other, some of which appear to be related to working or living building [2].

SBS should not convey the notion that the building itself is sick, but that the people in it may have one, some, or all of the symptoms that falls into SBS as per the definition offered by World Health Organization. Sick Building Syndrome is an umbrella term used to describe situations in which

occupants of the building experience discomfort and even severe health problems proportional to the duration of residence in the building, even when a specific illness or cause is not identifiable [2].

SBS is often related to the problems in indoor air quality, among which the most effective factors are often in fact a combination of potential factors, including indoor air pollution, lack of sunlight and daylight, poor ventilation and heating, poor acoustics and the presence of pathogenic elements such as asbestos. Biological contaminants are also of concern, for example, lack of sunlight along with high humidity provides grounds for the formation of molds and fungal contaminations [3].

If one wants to achieve optimality in design, harmony with nature should be primarily pursued, where humankind first found its origin a few thousand years ago. In the meantime, sunlight and daylight are heavily involved in keeping us in touch with nature while inside the building. Although this may seem simple and obvious at first, it would be

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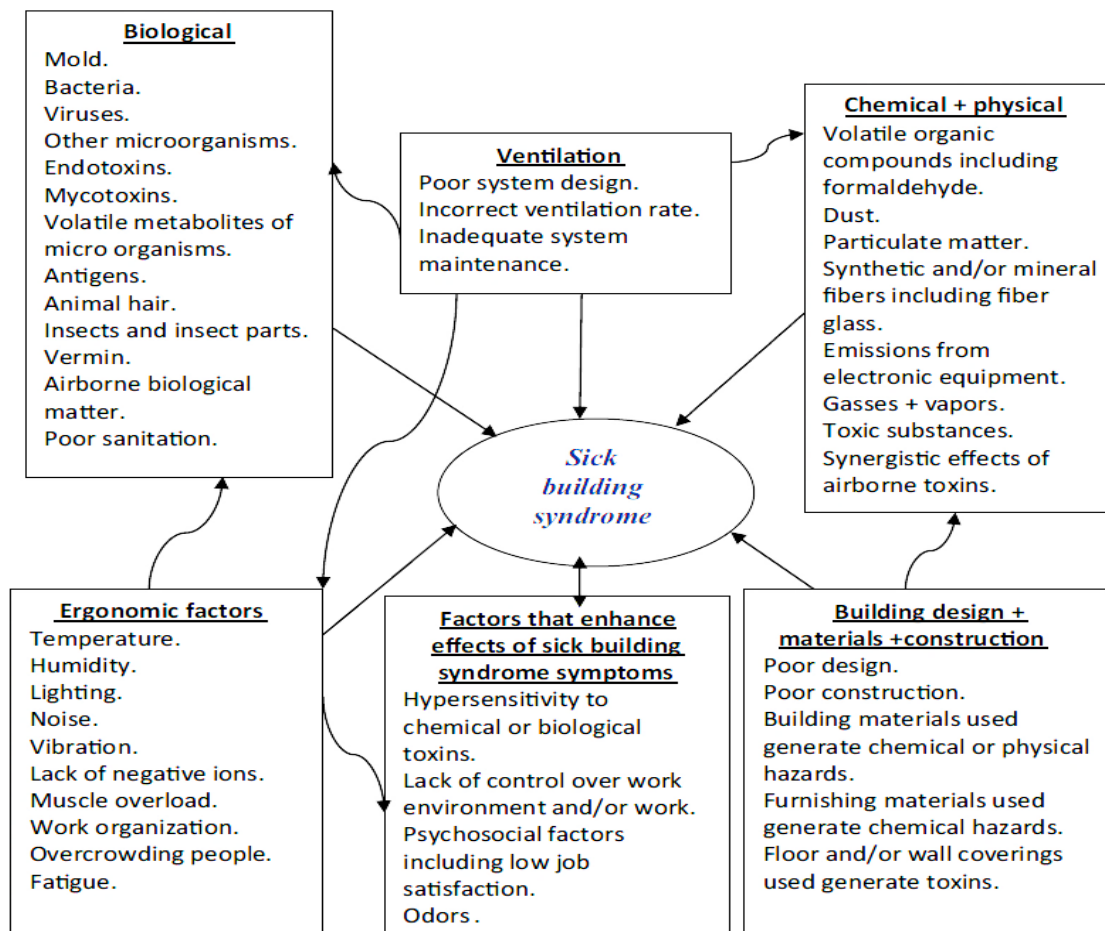
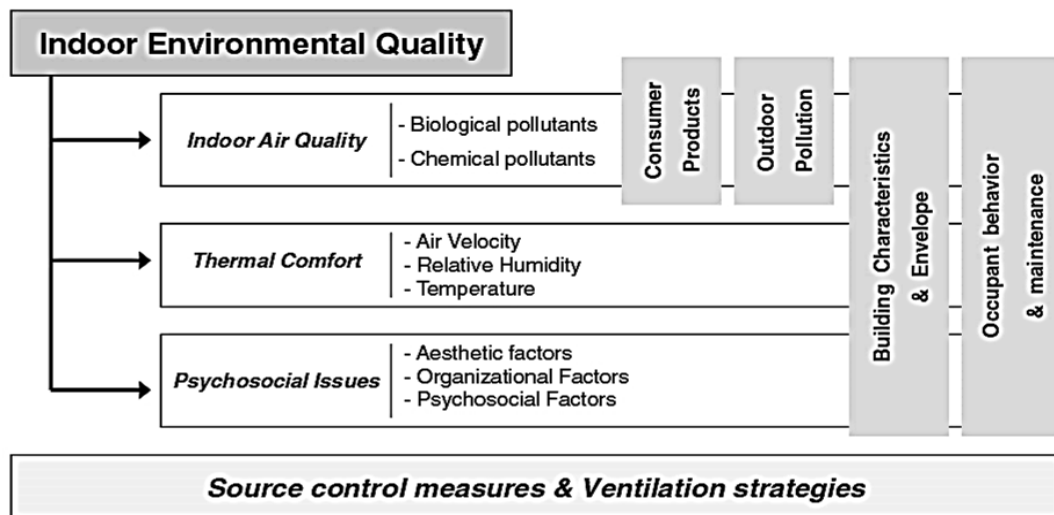
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very important to know that many of the health problems caused for building occupants may be the result of the underestimation of the significance of daylight by urban designers and architects. Thus, it seems that not carefully considering the basic design

accounting for natural light, especially in metropolitan areas, is the primary cause a wide degree of stresses, increased number of some acute diseases, reduced work and educational productivity and even increased duration of hospital stay [4].



Model of causes of sick building syndrome.

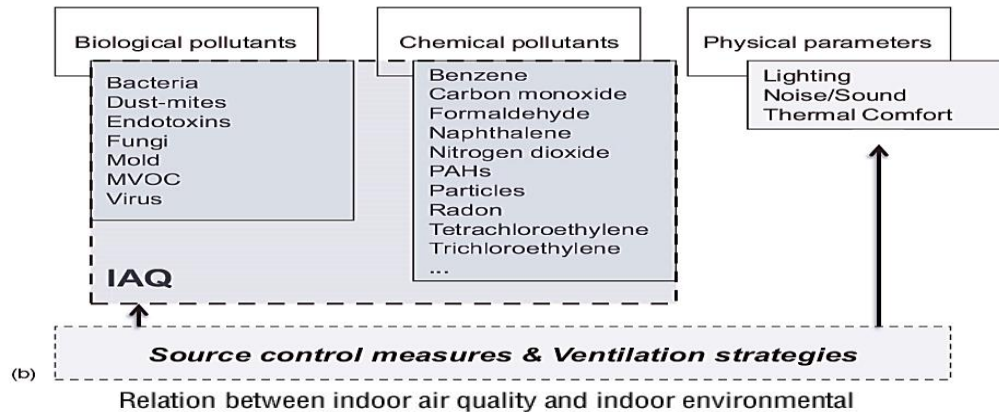


Figure 1. Source control measures and ventilation strategies; Model of causes of sick building syndrome; Relation between indoor air quality and indoor environmental

Reduced employee productivity

It is generally acknowledged that humans are in better mood during daylight, as most surveys on employees and office buildings show that employees prefer windowed environments to windowless ones. During sunlight, humans feel energetic and lively, but during the winter days we feel bored and even melancholy [5].

Decreased performance and learning in educational environment

Devotion to environmental quality factors in the designing academic educational spaces has a great impact on the performance of the main users of these spaces, i.e. students. In this sense, one of the most effective environmental quality factors is the introduction of daylight in the designing of educational classes [6].

Delays in patient recovery rate

In the mid-twentieth century, the famous English nurse Florence Nightingale was one of the major proponents of increasing the amount of natural daylight (sunlight) in homes and wards. She acknowledged that patients admitted to the well-lit wards were in higher morale and much happier than those admitted towards without proper daylight. Known as The Lady with The Lamp, she went so far as to offer architectural designs for low-rise hospital wards that received sunlight not from one direction but from two, thus achieving access to sunlight in the entire ward space [7].

The relationship of humankind with sunlight and natural light throughout history has often manifested in the form of religion and mysticism, such as belief in the sun god in ancient Egypt, which in some cases can be seen quite clearly on stone walls and masonry structures and even caves,

although the subject of daylight in its rational form entered the architectural realm from the late nineteenth and early twentieth centuries. Aside from the necessity to preserve energy and protect fossil fuels, the issue of sunlight gained more significance when Dr. Niels Finsen received the 1903 Nobel Prize in Medicine for proving that sunlight could cure tuberculosis. He also developed a method for treating cutaneous tuberculosis using ultraviolet light. Yet the remaining fact is that the light factor with a focus on human health is still often disregarded in design.

Daylight and natural sunlight

Visible light is a spectrum of electromagnetic waves that is visible to the human eye, varying from 405 terahertz bordering the red light, to 790 terahertz on the purple light. The human body has evolved in the daily cycle of light and darkness and has fully adapted to natural light, which is the result the visible light spectrum being combined, though the sensitivity of the human eye and even skin to any of the colors of the visible light spectrum is different. More importantly, daylight is not a constant flow of light, but a dynamic thing that is a function of time and place and contains information about the outside environment, including the situation of the day and the extent of coldness and heat. Therefore, the spectral quality of sunlight, which cannot be accurately produced artificially, makes it an entirely different type of light compared to what is produced by any electrical source [7].

Daylight and health

The relationship between health and daylight can be studied from both mental and physical perspectives. Natural light carries information regarding the day. This light gives us information

about the outside environment when we are indoors because our body is involved in daily shifts throughout the year and this circadian cycle directly affects the digestive system, sleep pattern, hormone secretion and even body temperature. The integrity of the body's biological clock is closely attributed to the amount of light it receives from the environment during the day. As a result, receiving enough daylight is very important for reducing stress, as it affects people's mental states [7].

People became more attentive to the importance of daylight when Dr. Niels Finson received the 1903 Nobel Prize for proving that sunlight could, in fact, cure tuberculosis. In 1984, Dr. Rosenthal and colleagues discovered that the improvement in their patients' depression was more due to sunlight than to the inhibition of the release of the melatonin hormone, as inhibiting the release of this hormone through prescription drug did not reduce depression.

It has been proven that, physically, sunlight is the main source of vitamin D. The medicinal and therapeutic properties of vitamin D were identified at the beginning of the twentieth century. The deficiency of this vitamin at first will lead to a decrease in bone density and hence rickets. Furthermore, there is a direct relation between vitamin D deficiency and the function of human cardiovascular system. In fact, vitamin D deficiency is an environmental factor that, regardless of the genetic factor, leads to heart failure and high blood pressure in people. Increased rates of high blood pressure in winter compared to summer is potentially owing to reduced levels of vitamin D in the body as a result of reduced exposure to sunlight. Although there is a plethora of dietary supplements for compensating for vitamin D deficiency, sunlight has been shown to be the main source of vitamin D, which no supplement or diet can replace it [8].

Moreover, a relation between vitamin D deficiency and an increased risk of various cancers has been previously shown. However, it should be noted that depending on the quality, time and place of sunlight, its effect can be either positive or negative. For example, excessive exposure to direct sunlight in a hot and dry climate can increase the risk of skin cancer. Sunlight provides, through photosynthesis and other processes, the chemical elements needed for our survival that are dependent on light. There are fundamental biological, hormonal, and physiological functions within beings that are synchronized through various cycles and are essential for the life of cells, plants, animals, and humans. When there is no sunlight, disruption of the

daily life cycle leads to the emergence and spread of diseases and abnormal behaviors in many plants, animals and humans. According to Salamat News, as quoted by ISNA, deficiency and insufficiency of vitamin D is common in approximately 30 to 50% of the world's population, although its prevalence varies in different geographical areas and varying nutritional and climatic conditions. Despite medical advances, vitamin D deficiency is still highly epidemic. 50 to 95% of the vitamin D in the body is supplied to the skin through sunlight, while the rest is supplied through food and supplements [8].

Urban design policies and designing requirements

A healthy person is not necessarily someone who is free of any disease, but health is actually being in a balanced state and appropriate physical, mental and social condition. Therefore, providing a living environment that meets the health requirements of residents should be considered with higher priority compared to visual criteria. Based on the aforementioned discussion, the acceptable level of daylight often manifests as one of the important factors of SBS within healthcare in the two scopes of urban design and architecture [9].

In the field of architecture, in most buildings, the issue of light and health is mostly overlooked and visual criteria are often valued higher. Nowadays, there is practically no requirement set for architects in this regard, as most of the criteria are associated with the safety of openings and exits. A severe lack of standardized criteria for improving the health of residents is more visible in this field than in the field of urban design and, of course, is accompanied with more complexity. It is trivial that daylight affects human mood, yet its extent and type depend on the very same human. No any two people see a building and a room in the same way, so despite the fact that there is no alternative to the architect's understanding of the needs and desires of people who want to live, work or play in a specific building, there must be climate-appropriate standards that on the one hand offer information on changes in the 24-hour cycle, and on the other hand give residents the ability to control their environment. Well-structured and consistent rules, standards, and guidelines that can also be generalized offer the architect reliable starting platforms in the design process. Criteria for the placement of stairs and emergency exits should be devised in line with the orientation of the building, the location of the bedrooms and living rooms, the depth of the rooms as well as the size and location of windows and shutters and the use of

special techniques with the purpose of providing the desired natural light inside the building. Having in mind that dazzling and excessive light is also annoying to residents and can even reduce visibility and increase health risks, the key point in designing based on daylight is to control lighting levels as well as control the direction of radiation and even the manner of light distribution by its occupants.

There are strategies in relation to the provision of indoor lighting through side windows, casements or skylights that the architect should consider in accordance with the particular design of the building. The corresponding methods include engineering the size and slope of the side windows and openings, the use of attic side windows with no visibility from outside, reflecting platforms in the side windows for reflecting light from the ceiling to the depth of the room, light guide towers, prismatic system employing light refraction and reflection mechanism, one-way ceiling monitors for incandescent light of winter, light tube system for directing sunlight to the lower floors in multi-story buildings, as well as intelligent systems for adjusting indoor lighting using sunlight. In any case, this issue requires the creativity of the architect, as it must be classified in the construction design standards [9].

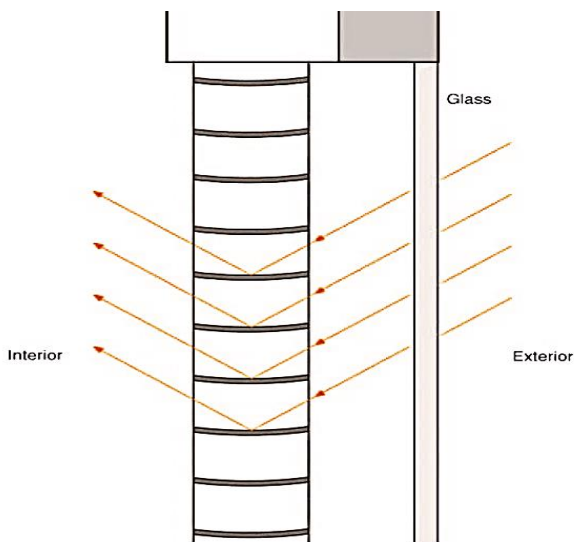


Figure 2. Light-redirecting louver system.

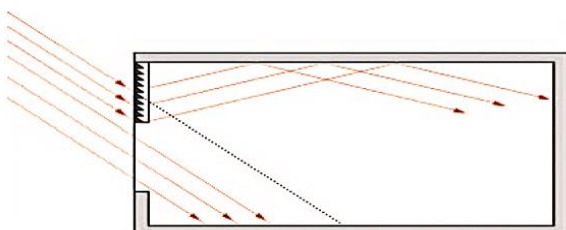


Figure 3. Prismatic panel inserted within a side window redirecting incoming sunlight.

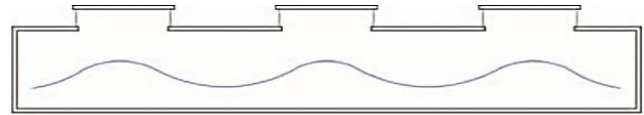


Figure 4. Two sided roof monitor system.

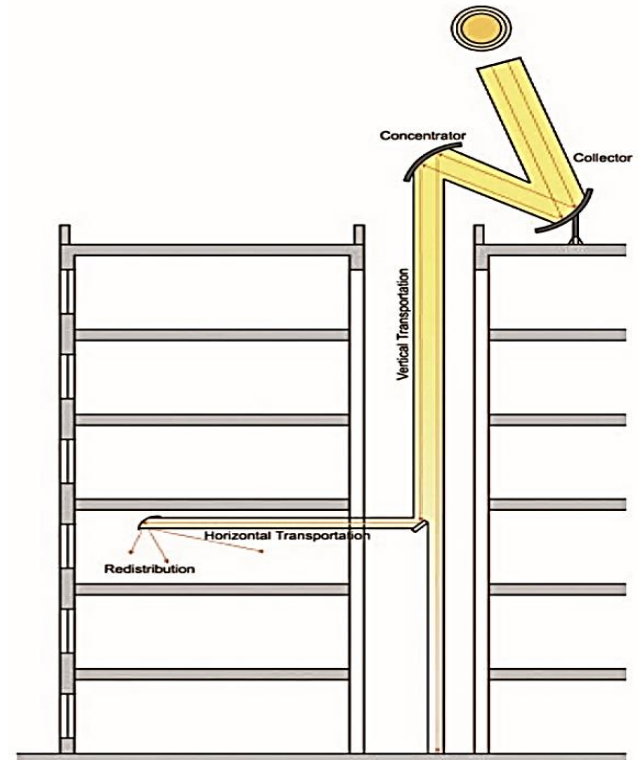


Figure 5. Alight pipe system with its various sunlight collection and light transport systems.

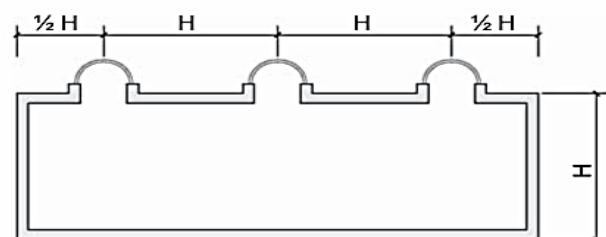


Figure 6. Rule of thumb for spacing skylights to obtain uniform light distribution beneath multiple skylights.

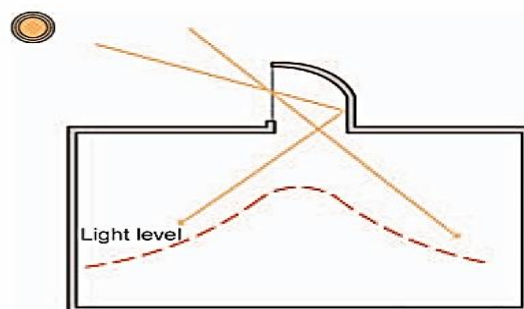


Figure 7. A single-sided roof monitor system designed to allow winter sunlight to enter but not summer sunlight.

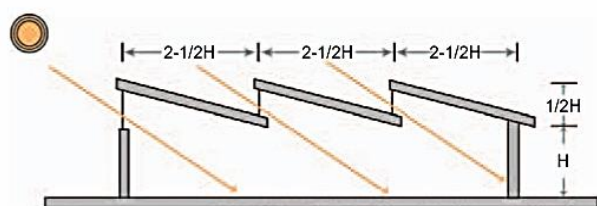


Figure 8. A single sided sawtooth system provides directional distribution of daylight inside the room.

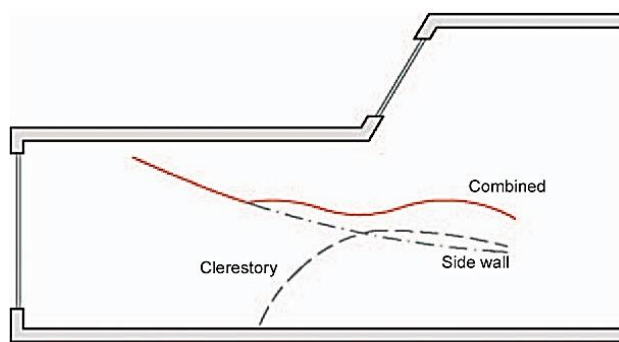


Figure 9. Daylight penetration resulting from the combination of an oblique clerestory and a side window.

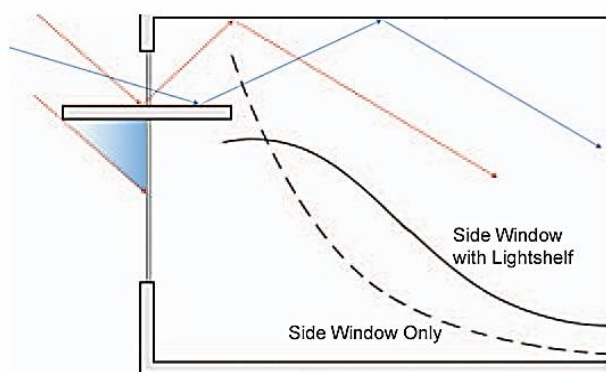


Figure 10. Daylight penetration from a combined lightshelf system.

In spite of all these solutions, designers may not be able to provide daylight in all parts of the building, and hence they can embed daylight-catching rooms, balconies, atriums and terraces in their design, where the occupants of the building can access direct sunlight.

CONCLUSION

It is evident that with the development of new industrial cities, various mental and physical disorders related to the living environment are emerging, problems that can be identified as a combination of factors under the notion of Sick Building Syndrome (SBS). Daylight is one of the most significant of such factors, the presence or absence of which affects the mental and

physiological health of the occupants of the building and their overall health in various ways. Natural daylight through windows and various forms of openings provides the connection for occupants trapped in buildings with the outside space, allowing them to closely sense the nature. Lack of sunlight can even be literally considered a poison as it leads to reduced levels of vitamin D in human body. Although severe SBS problems are often associated with the duration of time residents stay indoors and will gradually alleviate after leaving the building, not being attentive to this issue may lead to a plethora of severe problems such as heart failure, vascular complications and even the emergence of some serious diseases, as people nonetheless spend a significant share of their lives indoors.

An expert look at the manner of construction in the country reveals that the issue of daylight and health in design in most cases has fallen victim in expense to mass production and economic greed of estate owners. Although a significant share of this problem can be attributed to regulatory problems, more importantly, the development of criteria focusing on the health of residents, accompanied with a solid administrative guarantee, seems to be the key to solving this problem. In this regard, regulation and criteria related to urban design and architecture policies should be included as standards and instructions in the agenda of activists of housing and urban development.

Furthermore, an architect should use natural daylight management strategies inside buildings, considering the parameters of direction, intensity, distribution and controllability in the process with the aim of optimizing design. In this sense, not issuing work permits for non-professionals and having continuous monitoring of design and implementation processes can prove be very promising.

DECLARATIONS

Authors' contribution

All the authors contributed equally to the work presented.

Competing interests

The authors declare that there is no competing interests.

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- [9] Boubekri M (2008). Daylight, Architecture and Health Building Design Strategies, Elsevier. [Google Scholar](#) <https://www.sciencedirect.com/book/9780750667241/daylighting-architecture-and-health>

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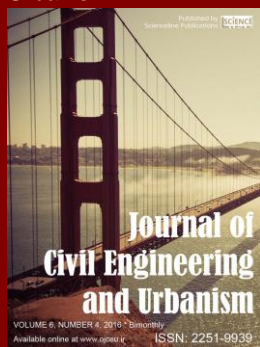
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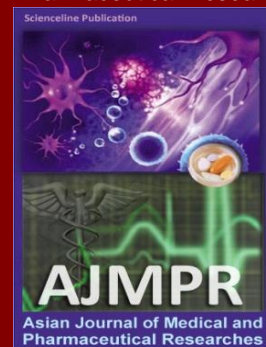
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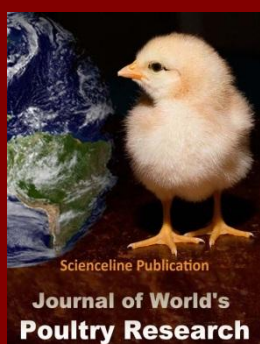
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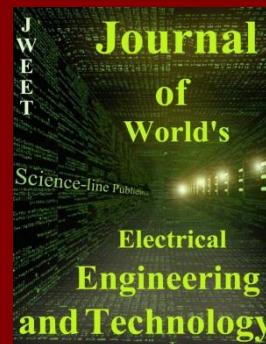
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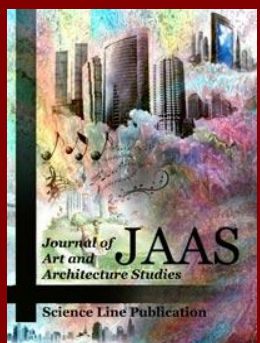
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