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ARTICLE

HIGH-RISE RESIDENTIAL COMPLEX WITH AN EMPHASIS ON BIOCLIMATIC ARCHITECTURE PATTERN IN TEHRAN DISTRICT 22

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ABSTRACT

Today, tall building in large cities, particularly Tehran is very common. High-rise buildings are the result of demands and needs of society and the advancement of technology. Population growth - demand - lack of housing - land expensiveness are among factors which have raised tall building as a necessity, but another issue that is important here is considering the bioclimatic principles. Accordingly this study examines the climate place in the design of high-rise residential complex with the aim of increasing building density in connection with climatic and environmental conditions. In this regard, many researchers have carried out an investigation. In this research the method is descriptive - analytic. The data was collected through desk and field studies - electronic and climate consultant software where using the meteorological statistics and bioclimatic tables and so on, Tehran climate and the impact of climatic variables on building were evaluated. Finally, sustainable architecture is studied and strategies for designing climate are presented. Results of the study indicate that to establish and form the building, it should be proportional to the current of sunlight and wind and also for the optimal use of the sunshine and avoid annoying forces, canopies and appropriate materials and window should be used and to reduce energy consumption, solar energy and wind in tall buildings can be enjoyed.

KEY WORDS

residential complex - design - biocli matic – District 22 - high-

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INTRODUCTION

The emergence of tall buildings in our country are affected by the conditions of society and the result of limitation of levels of construction, rising price of land, increasing population and demand, housing shortage, shortage of land for construction. If the construction of tall buildings is not done in accordance with scientific principles in the field of urban planning, architecture, mechanical and electrical installations, bioclimatic conditions of project, it has many adverse and irreparable effects. Therefore, considering climatic and environmental factors in the development of residential space is not a new debate. As we know, one of the foundations for the formation of Iranian architecture, is the climate. Accordingly, architecture of hot and dry - temperate humid - hot and humid regions and so on have found its identity and structure. From the beginning, man tried to create a favorable residential environment and in accordance with the thermal and climatic conditions of their living conditions. However, in a period due to misunderstanding of Modernism view, the residential texture has changed from a dense and closed form into row houses on small and equal pieces and in one form regardless of the climatic characteristics and is still ongoing and results in loss of vitality of residential space. And in later periods, the architectures still underwent changes, but today we witness the establishment of a new style called constructing-and-selling for economic reasons. Nevertheless, human nature is such that always wanted to create an architecture compatible with the climate. In the meanwhile, attention to relations between human and his living environment has become very important to him to be satisfied. So now in solving housing problems, architects should make non-breakable relationship between the building and the environment and climate.

1.1. The importance and necessity of research

- Today due to increased constructing-and-selling style and inconsistency of building with climate, principles and rules should be provided to prevent the crisis in the housing area.
- Often residential complex design is not based on people's physical and mental needs and does not provide heat comfort inside buildings. It is better to design complexes that meet people needs.
- High-rise buildings are faced with the problem of the cost of heating and cooling systems, measures should be taken to reduce the costs.
- Observing climatic design principles and architectural standards to improve the quality of residential spaces that connect the building with its surroundings.
- Considering geological features and conditions of project to make effective use of the potentials and strengthen environmental characteristics of the project site.
- Taking advantage of the facilities to strengthen the urban and natural landscapes.
- Tall building development and optimal utilization of land due to the shortage of housing and expensive land.
- Use of neighboring land use capacity and causing good communication with the outdoor.

- Creating modernity in architecture of building and avoiding repetition of common ways of construction of housing complexes.
- Linking building and relationship of building with the topography of the land.
- Creating a sense of place and linking man and his environment.
- Use of renewable resources and reducing building energy consumption.

1.2. Research objective

Providing housing production with new patterns which are complied with climatic conditions of the project site.
Creating a residential complex that enhance residents' satisfaction of creating thermal comfort inside the building and improving the living conditions.
Creating public spaces and private and semi-private hierarchy that increase social interaction.
Creating a residential complex which is related to the environment and meets the psychological needs of residents.
Establishing a prominent residential complex for settling urban people with middle and upper income strata.
Creating a prominent residential complex in district 22 in Tehran.
Creating green space on roof and terrace to create environmental comfort and improve climatic conditions.
Increasing building density to increase the population and shortage of land for construction.
Presenting climatic design principles to reduce building energy consumption.

1.3. Research questions

1. What are the effects of climatic characteristics of district 22 of Tehran on architecture of that district?
2. How can we consider the climatic characteristics (environmental) of District 22 of Tehran in the formation of residential complex?
3. How can we promote resident satisfaction by using climatic potentials in shaping the residential complex?

Answer to the above questions will be given in the findings while examining the role of climatic elements in the building and designing a house in harmony with the climate.

1.4. Hypotheses

1. It seems that the climatic characteristics of district 22 of Tehran will be effective on the architecture of the area.
2. It seems that to form the residential complex of district 22 of Tehran, environmental factors can be used.
3. It seems that due to climatic features in the design of housing complexes, residents' satisfaction can be enhanced.

The validity of the above hypotheses will be proved in examining the role of climatic factors in building and designing a house in harmony with climate.

1.5. Research literature

Climatic factors are very effective in climatic design. Several studies have been done in the world on climate adaptation. For example, in 1953 Olgi has scientifically raised the humidity and heat condition in relation to human needs and ecological design. He attempted to draw the bioclimatic table. Geoni presented the building's bioclimatic charts in the 80s. Poor Jafar and Mahmoudi Nejad have discussed the necessity of applying the principles of ecological design in cold regions [1] . Hoshyari (2006) examined the fundamental studies of climate and architecture in design of residential space in Sareyn, architecture climate and comfort of the city [2]. Jahanbakhsh (1998) has presented an article entitled assessing human climatic condition in Tabriz and thermal requirements of the building. Tavassoli in 1981 has studied the construction in Iran's arid climate and have examined necessary items in the building in relation to climate [2]. Salighe has studied modeling housing in harmony with the climate in Chah Bahar. Tavousi et al., have evaluated the climate and architecture of modernized schools of Isfahan [3]. Yang in his article (2007) entitled "environmental skyscraper design" has introduced these construction mainly as the most non-ecological construction method, and he suggested some strategies for decreasing the negative environmental impacts and improving the quality of user activities and proposed strategies in the form of three types of systems: interactional, passive and combined for high-rise buildings [4]. In addition to the harmful environmental effects, these buildings have psychologically negative effects on users; therefore, to it is of great significance to follow-up and focusing on sustainability objectives in the design of high-rise buildings and it could partially provide psychological welfare of users. The potential role of sustainable buildings in promoting the health of users by creating natural environments and thus improving the quality of interior spaces is clear [5].Research in the field of climate adaptation in Iran focus mainly on bioclimatic zoning and earlier studies and has less focused on climatic design and we in this study tried make the debate on climatic design more applicable and be considered in research and design - climate phase and climatic potentials.

1.6. Research method

The research method has a quantitative - qualitative approach and the research method is descriptive – analytical based on field studies (slides and photos), desk study and electronic study and climate consultant software is also used for the analysis of meteorological statistics.

1.7. Studied area

District 22 of Tehran Municipality is located between the East longitude 10" 5' 51 to 40" 20' 51 and Northern latitudes 16" 35' 32 to 19" 57' 35 in the northwest of Tehran and in the downstream of Kan and Vardij River basin. The district is restricted from north with Central Alborz mountain, in the East with Kan Rivers, in south with Tehran - Karaj freeway and in the West with a range of Vardavard planted forests and is contiguous with areas 5 and 21 of Tehran Municipality. Therefore, the northern boundary of District 22 of Tehran Municipality is developed to the extreme southern slopes of Alborz to a height of 1800 meters. Alborz Mountains which attracted the city over 30 past years, surrounds the surrounding Tehran's geographical space as crescent-shaped wall and in the height of 1800 meters due to the sharp steep and mountainous bottlenecks has created a tough barrier to city physical expansion. In district 22, the highest elevation above sea level is in the straight line of northern catchment area of the Alborz heights and in the East of Kiga Village by 3840 and the lowest level is at 1220 meters altitude in Peykanshahr city exit. The area of this district is 54,000 ha including highlands which its maximum length and width approximately equal to 26 and 17 km. The distance of West is about 11 kilometers to the beginning of Karaj. Kan River path that flows from north to south after exit point is drawn in the east area of plan and receives eastern basin surface water which is connected to it through diversion channels. Vardavard River also flows along the north-south and parallel to Kan River and is extended in the northern part in the West of central region, which in downstream, forms the west of zone. The average distance of the two rivers from each other is about 10 km.

Based on the preliminary results of Census in 2006, population is approximately about 138,970 people.

Fig. 1: Location of Tehran on Iran map

Fig. 2: Location of District 22 on Tehran map

Research theoretical principles

Each building which height (vertical distance between the disposable floor level of the highest floor to the lowest level accessible to fire engines) is more than 23 meters is considered a tall building. (PBO - 1995).

2.1. Start of construction of high-rise residential buildings in Iran

Construction of high-rise residential buildings was begun after development of apartment ownership constitution. The law was passed for the first time in 1954, followed by approving Article 100 of Direct Taxes Act in 1956, construction of tall buildings was accelerated.

The content of the Article is encouraging the private sector to invest in the construction of high-rise residential buildings. The first high-rise residential buildings in Iran are Tehran Saei Park apartments which are built by the Housing Authority in 1954-1960 [6].

2.2. Necessities and building conditions

Requisites that necessitates the construction of such buildings and conditions under which the implementation of these buildings are recommended can be summarized as follows:

1. Increased demand for housing production due to population growth in large cities,

2. Fixing the limitations imposed by the shortage of urban lands
3. The need to control the horizontal expansion of cities,
4. The high cost of land in densely populated areas such as downtowns,
5. Lower horizontal distances in urban travels,
6. Construction of distinctive buildings in the city,
7. Necessity of renovation and beautification of cities,
8. Creating points of emphasis in the city.
9. Creating points of emphasis in the city [6].

2.3. Climatic design

Climatic design is a way to reduce building energy overall. Designing building is the first defense line against climatic factors outside the building. In all climates, buildings that were built based on the principles of ecological design, minimize the need for mechanical cooling and heating and in turn use natural energy available around the building [7].

2.4. Sunshine

Sunshine is "an electromagnetic radiation". Solar spectrum is divided into three parts: UV - visible - Infrared. Wavelength of UV radiation is 0.28 to 0.4 micron, visible beam is 0.4 to 0.7 and the wavelength of Infrared is higher than 0.76 microns. Given that the maximum intensity of sunlight is in the visible light, but more than half of solar thermal energy is related to infrared [8].Sunshine is one of the most important climatic elements which affects building direction, building form and performance of interior spaces.

2.5. Air temperature

The temperature shows cold and warm air and is measured with a conventional thermometer. The ordinary thermometer is called dry thermometer and the temperature measured by it is called temperature of dried air. Since ambient air temperature is one of the factors affecting thermal comfort, the architect should be familiar with changes in temperature of studied location. For the purpose, reliable sources of information such as statistics of Meteorological Organization are used [9].

2.6. Wind

Wind is the air flow moving from high pressure to low pressure centers. The more the differences of pressure between two points, the air flow rate will be higher. Wind is a climatic element which important role in designing climate must be considered. What is considered from the impact of wind in building is the effect of wind on natural ventilation of the building and its impact on the direction and form of building.

2.7. Sustainable architecture

Richard Rogers defines sustainable architecture in this way: sustainable design is seeking to meet the modern needs, without compromising the natural resource and leaving it for future generations [10]. Principles of sustainable architecture**:** 1. Energy conservation 2. Working with climate 3. Reduced use of new sources 4. Respect for user 5. Respect to the site and 6. Holism [10].

MATERIALS AND METHODS

Instruments used in this research is the statistical data collected from metrological station of Cheetgar including mean monthly temperature - mean monthly wind speed and mean maximum wind direction and speed. Then using it, Tehran climatic elements will be analyzed using the climate consultant and by analyzing the role of these elements in climatic design of features of houses in harmony with the climate.
Results**:** In this section we analyze the hypotheses using evaluation of conditions and the effect of climatic elements in District 22 of Tehran on tall building and sustainable architecture to present design criteria and solutions for climatic design.

3.1. Analysis of Tehran climatic elements

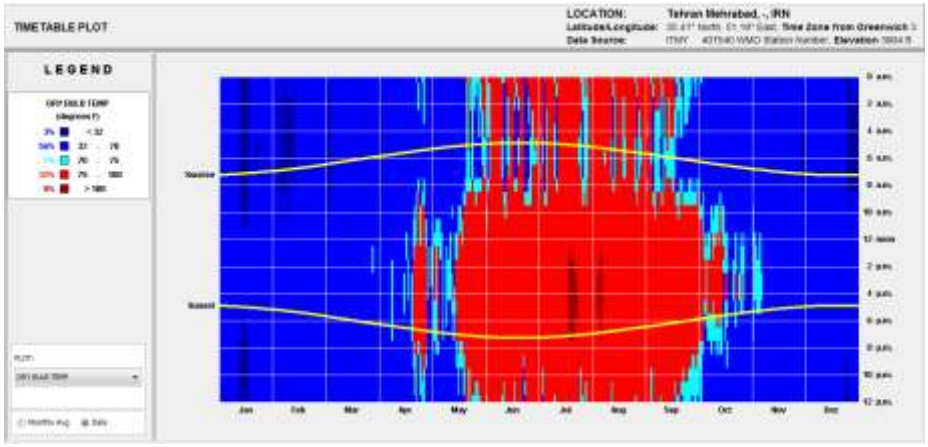
Average monthly temperature**:** In this table, average monthly temperature since 2000-2014 is examined, indicating that the maximum average temperature belongs to July and August and minimum average temperature to January and February.

Table 1: Information of average monthly temperatures [12].

Information of Average monthly temprature												
Year	January	February	March	April	May	June	July	August	September	October	November	December
2000	4.9	6.7	11	21.3	26.6	29.3	31.5	31.4	27.8	18.4	10.1	6.3
2001	4.6	7.6	14.2	20.9	24.6	29.5	30.3	31.5	27	20.4	11.9	8.5
2002	4.6	8.8	13.7	15.5	23	28.8	31	31.6	29.5	23.6	12.5	3.5
2003	6.1	6.3	9.7	16.4	21.3	28	32.4	30.6	26.1	22.7	11.1	5.4
2004	5.7	8.7	13.7	15.3	21.8	29.4	29.6	31.9	26.9	20.5	12.7	4.2
2005	4	3.5	12.2	18.6	22.1	28.8	32.5	30	27.7	21.2	10.8	9.3
2006	1.9	8.8	13.7	18.9	24.8	30.9	31.6	31.8	26.4	21.1	10.8	2.9
2007	4	7	9.1	16.5	23.9	29.4	30.9	30.5	26.8	19.8	14.1	4.4
2008	-3.3	4.1	17.1	20.7	24.3	29.4	31.8	30.7	27.2	20.4	10.7	5.5
2009	4.4	8.2	13.6	13.7	23.5	27.4	32.3	30.6	25	19.9	11.7	7
2010	8.3	8.4	14.5	18.2	23.7	31.1	33	29.9	26.5	23	13.3	10.1
2011	3.9	6.1	10.5	18.9	24.2	30.5	32.7	30.5	26.3	18.9	7.4	5.3
2012	4.7	3.6	9.1	18.2	24.7	28.9	31.1	31.5	26.4	20.2	12.6	6.1
2013	5.9	8.2	14.2	15.9	21.5	27.7	31.7	30.8	29.6	21.4	14	7.9
2014	7.3	6	11	18.8	24.4	28.9	30	32.7	27.4	19.2	9.4	6.9

3.2. Plot timetable graph

In this diagram, two horizontal curves are sunrise and sunset. The horizontal axis is month and vertical axis shows hours and a big stain in the middle is the heat.



3.3. *Position and angle of sunshine at latitude 35°*

According to Figure 4, the angle and position of sun in July - October - March - April were reviewed.

On June hour 12 Sun angle 180° position of the sun N 80°
October hour 12 Sun angle 58° position of the sun N 180°
March hour 12 Sun angle 47° position of the sun N 180°
April hour 12 Sun angle 58° position of the sun N 180°

3.4. Wind in Tehran

According to the monthly maximum wind speed is in Tehran in June - May - April and the lowest monthly wind speed is in December and November.

Table 2: Information of average monthly wind speed [13].

Information on average monthly wind

Year	January	February	March	April	May	June	July	August	September	October	November	December
2000	2.1	2.5	4	3.4	3.6	2.8	2.3	2.1	2.2	1.8	1.7	1.2
2001	1.3	2.8	2.1	3.7	3.1	2.9	3	2.5	2.3	2.2	1.9	1.2
2002	1.9	3.4	3.2	3.7	4.2	3.9	3.1	2.5	1.7	1.8	1.7	2.2
2003	1.9	2.8	3.3	3.3	3.1	3.4	3.1	2.4	2	2.3	2.4	2
2004	1.9	3.2	2.4	3.2	4	3.3	3.2	2.9	2.6	2.5	2.6	1.8
2005	2.2	2.5	4.1	3.5	3.7	3.4	2.9	2.7	2.2	2.1	1.7	1.4
2006	1.9	2.8	3.1	3.4	3.5	2.6	3.1	2.3	2.4	2.7	2.6	1.8
2007	1.9	3	3.6	3.1	3.2	3.3	3.1	2.6	2.2	1.9	2.2	1.9
2008	1.5	2.6	3.5	3.4	3.9	3.4	3.1	2.6	2.8	2.7	2.3	1.8
2009	2.3	3.6	4	3.4	3.4	3.1	3.4	3	3.1	2.2	2.9	2.2
2010	3	2.9	3.2	4	4.2	3.2	3.1	2.6	2.5	2.6	1.4	1.8
2011	2	3.6	2.9	3.9	4	3.8	3.3	3.2	2.7	3.1	2.3	1.9
2012	2.8	2.9	4.4	3.4	4.1	3.3	3.1	2.7	2.7	2.6	2.1	2.2
2013	2.8	3	3.8	3.5	4.2	3.9	3.4	3.2	3.1	2.8	2.1	2.8
2014	2.8	2.6	4.1	3.9	3.8	4.1	3.4	3.1	3.1	3.4	2.3	2.2

3.5. Direction of prevailing winds and maximum wind speed

According to Figure taken from Kasmaee book on April 13 to May 11 and a maximum speed of the prevailing wind is 12.4 from the West. In May and June, wind speed is 11.4 from the West, in May and June the speed is 6.2 from Southeast and in June is 6.8 from the southeast, in July and August, it is 5.9 from the southeast, in August and September it is 5.9 from the southeast, in September and October it is 5.9 from the northwest, in October and November it is 4.9 from Southeast and in November and December it is 9.8 from the southeast - in December and February is 3.9 from southeast and February and January is 11.1 from the southeast, in February and March it is 11.6 from the southeast, in March and April the speed is 12.7 from the Southeast.

The following table also shows the direction and speed of the maximum monthly wind since 2000-2014

Table 3: Information of monthly maximum wind direction and velocity [12].

Information of wind direction and speed, maximum monthly/wind speed based on m/s

Year	January			February			March			April			May			June			July			August			September			October			November			December		
	speed	direction	Day	speed	direction	Day	speed	direction	Day	speed	direction	Day	speed	direction	Day	speed	direction	Day	speed	direction	Day	speed	direction	Day	speed	direction	Day	speed	direction	Day	speed	direction	Day	speed	direction	Day
2000	14	270	7	12	280	26	17	270	15	24	270	19	14	270	3	20	30	17	10	150	7	16	180	7	15	270	5	10	270	1	15	260	28	12	300	16
2001	11	250	13	15	230	21	20	240	25	17	270	9	20	270	16	14	270	1	15	270	20	15	300	10	15	260	17	16	270	21	15	270	18	14	270	21
2002	16	270	31	18	270	16	17	260	6	20	270	18	20	270	3	14	270	7	15	250	26	8	120	6	10	300	22	14	270	29	15	270	12	12	170	22
2003	14	270	7	16	270	26	15	270	8	20	330	10	20	270	15	15	260	6	10	260	31	18	270	22	10	260	13	20	270	3	16	290	21	15	280	21
2004	12	270	15	20	280	15	15	270	3	15	270	1	17	250	17	15	210	21	15	270	6	10	150	7	10	270	4	15	300	14	17	270	28	10	270	17
2005	13	270	25	15	270	22	15	270	21	18	270	5	15	300	9	14	250	7	10	260	7	15	270	14	8	270	6	16	300	7	15	260	6	12	240	20
2006	10	240	17	14	270	28	17	300	27	20	240	22	25	270	17	10	270	30	12	150	8	10	250	13	13	240	27	16	270	19	15	280	7	16	270	8
2007	16	270	17	15	280	5	20	300	6	20	300	27	20	240	12	18	270	3	16	270	19	10	130	22	8	160	1	13	270	18	14	300	12	14	280	20
2008	10	260	28	15	280	20	23	290	15	16	270	30	16	280	2	16	260	3	14	260	24	14	40	25	20	270	10	11	350	1	10	270	21	9	270	13
2009	13	270	2	14	250	2	20	120	30	16	230	30	15	280	17	15	210	10	10	270	6	14	140	18	13	280	17	8	240	25	14	240	3	13	280	15
2010	15	270	21	13	290	22	15	260	21	18	290	23	19	280	7	12	90	21	11	270	15	9	130	25	12	270	15	12	250	12	8	250	1	14	260	14
2011	12	270	28	13	260	22	17	240	29	16	270	26	23	270	19	14	160	23	15	270	21	14	310	25	9	280	20	14	270	4	12	270	21	11	270	11
2012	14	250	3	14	250	2	26	320	18	25	290	17	15	300	24	15	300	30	10	270	31	12	120	1	9	280	23	24	260	12	11	240	14	10	270	7
2013	14	270	30	13	270	13	15	270	19	18	270	21	20	280	16	15	280	2	12	270	3	13	270	31	12	260	25	10	270	8	10	280	30	14	270	10
2014	17	280	31	12	240	28	15	250	31	12	240	1	19	240	24	30	270	2	10	270	28	10	10	19	13	270	23	15	270	20	13	240	3	12	270	2

3.6. Number and direction of wind

Based on the charts and tables presented, highest percentage of wind is in summer in the Southeast Front. In winter we have highest wind in West Front, in spring we have highest wind in West Front, we have the highest wind in the autumn in Southeast - South - West and North Fronts and we have about 20% of wind in West - 12% in southeast -10% in South -7% in Southwest - 5% North- 5% in Northwest and 3%.in Northeast. West wind > South wind > North wind

Role of climatic elements in building

5.1. Impact of sunshine on building

Sunshine create natural lighting inside the building but since the high amount of its high and unnecessary amount cause disorder in thermal comfort of humans, therefore its infiltration into the building should be prevented. Sun control in high-rise buildings has always been debated. Because heat loss in cold cases and heat absorption in hot times increases the cost of heating and cooling in a high floors.

5.2. Sun radiation on horizontal surfaces

Horizontal surfaces and flat roofs, in summer receive the highest and in winter the lowest amount of direct sun radiation. This amount, even in winter is less than the amount of radiation the southeast and southwest walls receive in this season [8]. And the impact of radiation depends on the type of roof and its material.

5.3. Sun radiation on window

Because of the transparency – low thickness and material, windows have very low resistance compared to the wall to absorb heat and enter high temperature into the indoor space. In high-rise buildings, due to the high area of windows, issue of the heat absorbed and the lost heat is very important and the radiation depends on the direction and type of windows.

Impact and performance of wind in indoor and outdoor

Air flow around a building: When the air flow encounters obstacles, such as tall buildings and is directed to the sides of the building and moves again in its direction and creates positive and negative pressures in front of wind and behind the wind. (Figure 4) and sharp corners of facades increase the flow (Figure 5). If there is empty and full spaces in the form of buildings and there is oblong in the corners, the speed of the flow is reduced. (Figure 6)

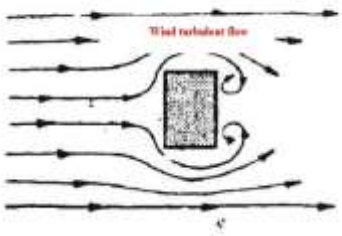


Fig. 4: Airflow around building, Source: Architectural Design Guide, Talebi

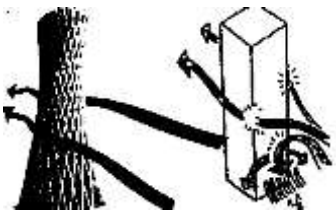


Fig. 5: Wind encountering with building, source:
criteria and process of designing tall buildings, Rezazadeh

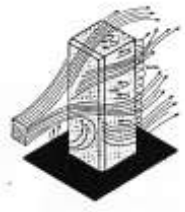


Figure 6: Various air flow around building, Source: Architectural Design Guidelines, Talebi

Performance of ventilation and need for it in building: Natural ventilation and indoor air exchange rate are the primary factors determining health and comfort of human. In general, natural ventilation inside the building has three different functions that are as follows:

Supply of breathable air inside the building through replacing external fresh air with polluted and consumed air

Physical comfort by raising the reduction of excess body temperature caused by evaporation of sweat on the skin.

Developing physical comfort inside the building through the cooling the mass of building materials when the air inside is warmer than the air outside [8].

6.1.Stability in the building

In climatic design, solar and wind energy can be used especially in high-rise buildings to reduce energy consumption and utilizing light and heat.

Use of solar energy: Enjoying more sun to provide lighting - heating - and, if necessary, electricity supply of buildings [6]. Use of wind energy: The use of wind energy in high-rise buildings due to the height of these buildings and high wind speed and intensity at altitude than low buildings has a higher efficiency. The use of this energy in natural ventilation of tall buildings (Atriums) and in the generation of electricity by wind turbines include solutions that are used in these buildings for sustainability [10].

6.2. Designing a house in harmony with climate

According to the analysis conducted about Tehran climate and relationship of climatic elements in designing building, features that a building must have to be in the thermal comfort are examined.Appropriate form of building: The more compact and denser the shape of the building is, thermal energy waste will be less and for better performance and efficient use of sunshine, building can be placed along the east-west axis to be less exposed to intense and stunning West and East sun. This creates comfort and satisfaction of residents in the building. Figure 8 shows different forms of tall buildings against wind power and Figure 7 shows suitable forms for high-rise buildings against lateral forces.

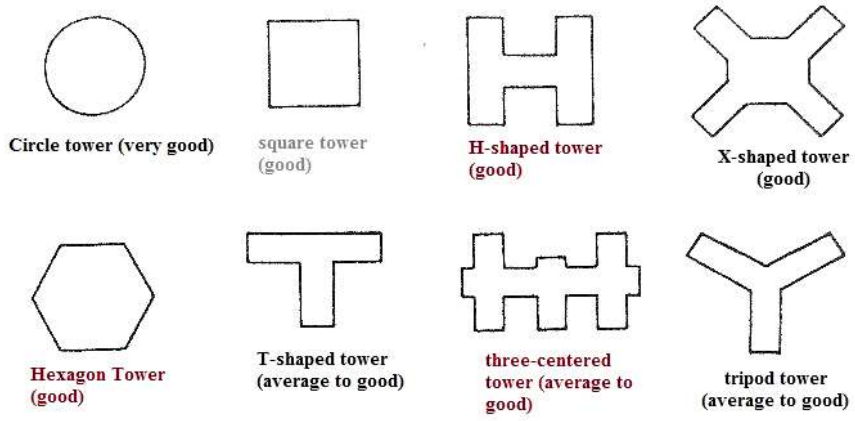


Fig. 7: Schematic forms of apartment buildings against wind power,
Source: Architectural Design Guidelines for high-rise residential buildings, Talebi

6.3. Suitable direction for building deployment

To determine the direction of the building due to climatic factors, the following two points should be considered.

- Taking advantage of the cooling effect of wind and avoiding the sun during hot times
- Taking advantage of the sunshine and stay protected from the wind in cold conditions

Skylight through East and West, facilitates the use of sunlight for apartments during hours of the day. But due to the extreme and dazzling heat and light of the West sun, appropriate controls should be carried out in front of it. The role of wind also is important in determining the direction of the building. To study the effects of wind in buildings, information about the direction, speed and time of local winds were studied [11]. With respect to the sunshine and wind, the best direction to establish building in accordance with Figure 8, is 22.5° southeast.

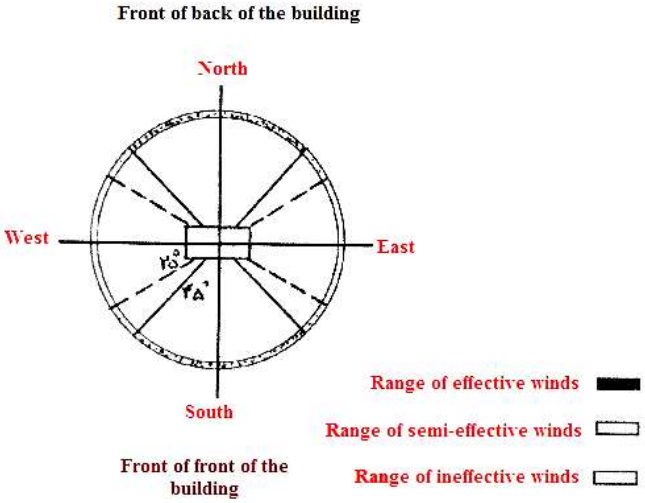


Figure 8: Direction of building, Source: Architectural Design Guideline, Talebi

6.4. Appropriate materials

Olegi method: In hot and dry areas, due to the large difference in day and night temperatures, building materials must be chosen carefully. In these areas, the best result is achieved when parts of the building that will be used during the day, is built with heavy materials and parts used in the evening and night, with light materials with low thermal capacity [8].

Geoni Method: Selection of Materials in hot areas: The most important factors determining the characteristics of building materials suitable for hot regions, is the maximum daily temperature and amplitude of its fluctuation. The amount of solar radiation absorbed in the wall is another important factor which depends on exposure and color of the external surface of the wall. The main characteristics of building materials depend on its thermal resistance and heat capacity.The best walls in warm areas are combined walls including an insulating layer close to external surface and a layer of heavy materials in the inside [8].

The use of Canopies: Canopies are very influential in preventing the penetration of heat into the building. They are divided into two categories: indoor and outdoor. Blinds and curtains are indoor canopies and fixed and moving are outdoor canopies.

Outdoor canopies: Animated canopies necessarily can be used in the case of heat out of the comfort zone. The darker the color, they will be more efficient. However, fixed canopies have specific performance and they can be used due to the building direction. Vertical canopies are generally installed for western and eastern walls and horizontal canopies for south and north walls.

Indoor canopies: The performance of the canopies is radiation reflection that is entered into the room space from the windows. Actually blinds and curtains are not effective means to control sunlight that's why they enter a lot of energy into the interior space and exit less energy due to the long wavelength of the radiations

from the window and the space between the glass and blinds will be very hot and the brighter its color, it is more efficient.

Using Atrium: Use of Atrium is one of the common ways in high-rise buildings which in both seasons (hot - cold) works appropriately to stabilize the building [6]. In the winter, atriums are spaces to store heat and in summer they do conditioning and remove the smoke.

Using photovoltaic cells: Photovoltaic cells are one of the most widely used applications of new energy. Lighting of buildings can be provided using photovoltaic cells. By calculating the energy required for lighting the building, the number of photovoltaic panels and storage capacity will be determined [6].

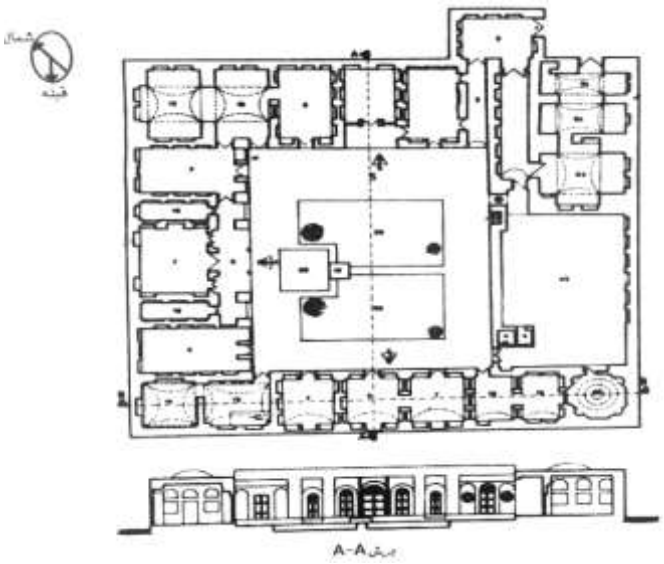


Fig. 9: Talkhoncheh Village Plan - Source: comfort in light of architecture, Razjouyan
- Dividing the house into two parts: hot and cold
- Creating a central courtyard

The need for high-rise building strategy, due to increasing population growth, housing shortage and limited suitable land in the present time is increasingly seen. On the other hand high-rise building should be based on climatic conditions of the region. For this purpose, this study analysed the climatic data from meteorological stations to assess the impact of climatic parameters in district 22 of Tehran. The results of this research show that this region has a hot, dry summer and cool and dry winter as well. The results of studies show the effect of climate on architecture and sustainable architecture and analyzes that have been conducted in this regard with the aim of providing architecture in harmony with the climate and the strategies and proposals show that most appropriate place for the establishment of a residential complex in the site according to wind direction and sunlight is 22.5 degrees south-east. And form of building for a suitable use of sunshine can be compressed and with east and west stretches. Building materials to store heat and its absorption and preventing heat loss should have a high thermal capacity. Window direction - area and their number are effective in the absorption of thermal energy. Use of canopies depending on the form and direction of the establishment of building for heat absorption modulation can have a significant impact. To reduce energy consumption using photovoltaic cells for lighting and electricity of atriums are effective for conditioning and generation of heat and ultimately sustainable architecture.

Recommendations for climatic design of residential complex are as follows

- To establish building to increase the use of winter sun and reduce the effect of summer sun and reduce wind turbulence in winter and maximize the use of summer breeze in Tehran climate, it should be 22.5 south-east.
- Plan spaces should be designed according to their performance in the direction of proper sunshine.

- Spaces such as warehouses and facilities should be built that are in front of the intense and dazzling sun and in fact have no well sunlight.
- The building should be divided into two parts hot and cold.
- Use of thermal insulation in windows and walls of buildings to resist heat flow.
- Selecting materials with high thermal capacity and bright color, preferably white in the summer to prevent heat absorption and resistance to the loss of indoor heat.
- To prevent heat loss and energy consumption in the building, use double-wall windows and walls.
- The number and size of windows in the northern, eastern, western should be reduced and southern side increased.
- Use of sun shades for the windows that are exposed to high heat. Canopies are divided into two categories: internal including curtains and blinds and externals including fixed and mobile.
- Use atrium for ventilation and heat absorption inside the building to reduce energy consumption.
- Use windbreaks to prevent the annoying winds.
- Use vegetation to cool the area – avoiding unfavorable winds and causing shadows besides the building.
- Use solar collectors on the roof or walls that receive a lot of heat.
- Use lawns on roofs and terraces and landscaping to create the suitable climatic conditions.

REFERENCES

[1] Pourjafar, Mohammad Reza - Hadi Mahmudnezhad [2007]. The effect of natural factors in reducing energy consumption of housing - a topic on the commitment and climatic design with an emphasis on cold regions of Iran - Journal of Civil Engineering. No. 42.

[2] Ramezani, Rasoul, [2008]. Climate and architecture of Zanjan, a Master's thesis, Islamic Azad University, Science and Research Branch of Tehran.

[3] Saligheh, M. [2004]. Modelling of housing construction in accordance with climatic factors of Chabahar. Geography and development 2: 4, 147-170.

[4] Yeang, Ken [2007]. "Designing The Eco-skyscrapers: Premises for Tall Building Design", The Structural Design of Tall and Special Buildings 16; URL: http//www.interscience. wiley.com.

[5] Wener R, Carmalt H [2006]. "Environmental psychology and sustainability in high-rise structures", Technology in Society 28; URL: http//www.elsevier.com/locate/techsoc

[6] Golabchi, Mahmoud, Mastari Farahani, Najme [2012]. Conceptual design of tall buildings, Tehran, Tehran University Press

[7] Watson, Donald, Labs, Kent [1993], Vahid Qobadian, Mohammad Feiz Mahdavi, climatic design, Tehran, Tehran University Press.

[8] Kasmaee, Morteza [2003]. Climate and architecture, Tehran, Khak publication.

[9] Razjouyan, Mahmoud [2009]. Comfort in the light of architecture in harmony with climate - Tehran - martyr Beheshti University Press.

[10] Golabchi, Mahmoud, Golabchi, Mohammad Reza [2012]. Principles of designing tall buildings, Tehran, Tehran University Press.

[11] Talebi, Jaleh, Kalantari, Iraj [1996]. Architectural Design Guidelines for Residential High-Rise Buildings, Tehran, Housing and Urban Development Research Center.

[12] Information Base of Tehran Meteorological Organization. www.tehranmet.ir.

[13] Information Base of Tehran District 22 Municipality. region22.tehran.ir

[14] Plan and Budget Organization [1995]. Procedures to protect buildings against fire - Tehran - Publication 112