

## 138: Challenge of Vernacular Architecture and Modern Life Style – Case Study in Iran

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### Abstract

The vernacular architecture of Iran has a reasonable relationship with climate conditions. Nowadays for some reasons, such as fast growing population, rising land and building price and the changes in life style densely layout and tall buildings are constructed in all cities and towns regardless to climate. This style of building construction causes essential use of mechanical heating and cooling systems.

The knowledge of the relationship between the climate situations, people's life style and the construction methods in an area will help the architect to innovate the principals of climate sensitive architecture. This article, based on field study research in 2007 [1], presents design norms for adapting new constructions to the moderate and humid climate in Gorgan, a small and under-populated city close to the Caspian Sea in north Iran.

In the following research, the climate requirements were determined after finding the climate and geographical specifications of the area. Then 4 periods of building construction in the city was recognized and the passive methods which were used in order to adapt buildings to climate condition and the problems of adapting new buildings to the climate were highlighted. Finally a set of design principles which are adjusted to the life style, economic situation and climate conditions is presented.

Keywords: climate sensitive architecture, modern life style, passive methods, energy demand,

### 1. Introduction

Not very long ago, different architecture styles were used in different climate conditions in Iran, which is known as "Traditional or Vernacular Architecture". This kind of architecture which is constructed based on natural conditions of the site, causes a reasonable relation between climatic requirements and building construction. Longer comfortable condition inside the building and less fossil energy demand is one of the results of this architecture. For some reasons such as: fast growing population, rising land and building price and the changes in life style using this kind of vernacular architecture is not prevalent in recent years. Nowadays dense and tall buildings are constructed in all cities and towns regardless to climate.

Applying the principles and guidelines of climatic design in construction and post-occupancy phases can reduce a considerable amount of fossil fuel consumption and environmental impacts, as it holds no extra costs to the builder or the user.

#### 1.1 Research Stages

This research provides climatic architectural design guidelines for the moderate humid climate of a sample city (Gorgan) by studying its climatic, geographic, and regional characteristics. The aim

of this study is to provide simple, easily-executable techniques for local builders. For this concern, vernacular and contemporary architecture in the city were particularly focused on to derive the guidelines.

These guidelines apply to all design stages in a project from the outset to the last. Arranged according to the process of design, they include: orientation and position of the building, compaction and layout of close and open spaces, size and direction of passageways and walkways, proper spacing of buildings, general mass and form of buildings, roof type, open and semi-open spaces in residential architecture (courtyards, porches), type of connection of the building to the ground, arrangement of interior spaces, placement of openings and their characteristics, characteristics of interior/exterior walls and their materials.

#### 1.2 Research Methodology

The research methodology is composed of three parts: 1) Accumulating library research findings and statistical data, performing calculations and compiling diagrams in order to analyze local climatic conditions. 2) Preparing architectural drawings of traditional and contemporary residential buildings and analyzing them with regard to climatic conditions. 3) Deriving climatic

design guidelines with an eye on economic, life style, cultural and construction factors.

## 2. Geographic and Climatic Characters

First of all geographic and climatic characteristics of the city are examined, and then the climate is determined based on Gorgan's 50-year synoptic weather station data.

### 2.1 Geographic Characters

The city of Gorgan lies on the 36° 51' latitude and 54° 16' longitude, near the Caspian Sea, on the northern slopes of Alborz mountain range. Its altitude is below 120m, bordering the northern Hyrcanian forests.

### 2.2 Climatic Conditions

The climatic condition of the city has been determined by studying various factors prepared by meteorology station of Gorgan city [2]. Studying these data shows that:

- The need for heating living spaces is twice as much as the need for cooling them.
- Gorgan is a semi-humid city, so the weather become muggy from July to September.
- Rainfall occurs almost all year. Floods are probable in October, November, and March. Windward sides of the buildings need shelter against rain. Snowfall and frost rarely occur.
- Most days are either full- or half-cloudy. The dense masses of cloud appear in two thirds of the cold seasons. In the warmer months, less than 50% of the time the sky is clear.
- In the cold period, prevailing winds mainly blow from the South, while in other times they blow from the West. The most winds blow in spring and summer, at about noon. The fastest wind blows in spring from the west.

### 2.3 Analyzing Climatic Conditions

Current data is assessed using comfort scales. For interior spaces, Givoni chart [4 & 5] is used that in addition to human and climatic measures, takes into account the effect of the building envelope. For exterior spaces, Penwarden chart [6] is used that combines human and climatic measures, while also considering the active role of human intelligence in the use of such spaces. (Figure 1)

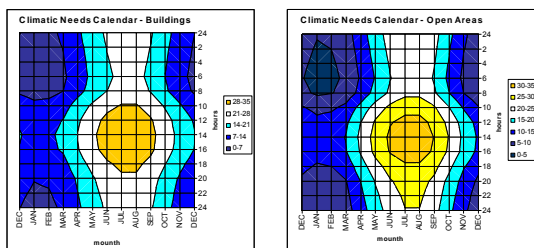


Figure 1: Climatic needs calendar of Gorgan

Overall studies show that Gorgan, generally, has a hot and semi-humid weather in summer and

a cold weather in winter. Muggy weather may occur in summer, so shading and constant airflow inside and outside the building is required. In a number of these days, the heat may become annoying so that cooling devices are needed. Winters are relatively cold, with cool, rain-bearing winds blowing from the west and the southwest. Frost rarely occurs, nevertheless, the wind chill in these nights demands the use of heating devices. About one third of the year there is sunshine, although not intense. Gorgan has medium annual rainfall that turns into driving rain when combined with westerly winds of spring, thus requiring protection for the western facades especially in higher buildings. Utilizing solar radiations for heating of open and closed spaces is necessary in the cold period.

## 3. Assessing Architecture Compatibility with Climate

After assessing climatic conditions, requirements of climatic design, and approaching to some basic guidelines, the architecture in the city was studied in this stage. Consequently, a construction typology was categorized based on the city's natural setting and its process of development in the past century.

Gorgan's architecture can be categorized into four types.

- Type A: the traditional architecture of the central part of the city related to more than 100 years ago. It is related to pre-industrial era that employs vernacular climatic control strategies.
- Type B: the oldest period in contemporary architecture that comprises low-rise, semi-compact fabric related to transferring from the traditional Life to the modern one, until 30 years ago. Its residential architecture is in the form of private houses with patios.
- Type C: high-rise, semi-compact fabric related to 15 to 30 years ago which has been erected replacing old buildings, either by private owners or by the government.
- Type D: high-rise and compact fabric regarding of the past 15 years and is widely expanding in the recent years. It is replacing the old fabrics and is comprises compacted fitted high-rise buildings.

Examining the contemporary architecture of the city in consecutive periods, it becomes clear that by moving forward, the richness of quality fades gradually, depriving architecture of the sense of time and place. Moreover, climate compatibility factors have been repeatedly weakened. Accordingly, human life has gradually parted from nature and natural qualities such as daylight, airflow, sunshine, natural ventilation and the picturesque landscape of the region. Recent housing not only has minimized the floor area and quantity of necessary spaces, but also has degraded considerably in terms of meeting standards of thermal comfort, falling beneath the minimum measures and depending completely on mechanical devices and fossil fuels. To assessing Architecture Compatibility with Climate the

acquired principles from the previous parts can be applied to different types of city fabric, then analyzed and contrasted. Here three main principles are examined as examples of all other principles that were studied in this research.

### 3.1 Principle I

*It is necessary to let breezes in to help remove moisture inside the building envelope and to ventilate interior spaces. Therefore, a single-layered building surrounded by open spaces is recommended. [3]*

#### ■ A - Traditional Fabric

Buildings are single-layered, facing the open space from two or more sides, and have multiple openings. (Figure 2 - right)

#### ■ B - Semi-compact, Low-rise Fabric

Buildings have a minimum of two (sometimes three or four) sides facing an open space, with multiple openings that link inside spaces to the outside. In addition, interruptions in the roof contribute to this effect. (Figure 2 - left)



Figure 2: Several openings to provide good cross ventilation inside the building.

#### ■ C - Semi-compact, High-rise Fabric

Apartment blocks have large open spaces on their northern and southern sides. In other words, the blocks are surrounded by open space.

#### ■ D - Compact, High-rise Fabric

If a housing unit has two sides facing an open space, ventilation of the interior spaces can be secured, whereas attached units that face the open space on only one of their sides are totally dependent on mechanical devices in terms of lighting and ventilation of their deep interior. (Figure 3)

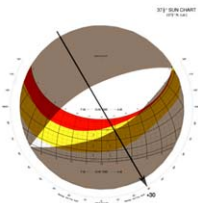
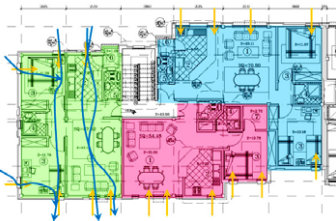


Figure 3: In some cases, because of the high compaction of the fabric, natural light and ventilation is not possible.

### 3.2 Principle II

*In this region, use of semi-open spaces when protected against direct rain and sun, is particularly advantageous because of the natural airflow. [3]*

#### ■ A - Traditional Fabric

Most often in traditional buildings, semi-open spaces act as intermediate spaces such as porches that link the entirely closed with open spaces. Aside from protecting the facades and the openings from rain and sun, they house daily activities of the inhabitants through half of the year when the weather is convenient. In some cases, these spaces function independently from closed spaces. They mostly constitute summer living areas on the upper stories. (Figure 4 - left)

#### ■ B - Semi-compact, Low-rise Fabric

Semi-open space in these houses constitutes a roofed porch that acts as part of the entrance, although the floor area has decreased as compared to older examples. Daily activities still happen in the porch, which is adjacent to main areas such as the kitchen, the living room and the patio. In other instances, the semi-open space is built separately in a corner of the patio with a function similar to an attached porch. (Figure 4 - right)



Figure 4: Semi open spaces were used as living spaces in most good climatic conditions.

#### ■ C - Semi-compact, High-rise Fabric

Semi-open spaces in this kind of apartment blocks are planned as small balconies that only accommodate for functions including drying cloths and the like. Yet, their advantage is that they have allowed for the windows to be mounted from floor level, allowing for airflow at this level. (Figure 5)

#### ■ D - Compact, High-rise Fabric

Newly built residential sectors have so small balconies that can only be used for storage. Soon with the continuation of this trend, they will nevertheless be omitted. (Figure 5)

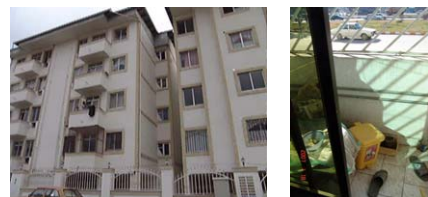


Figure 5: In recent years semi, open spaces are used in the minimum size as store space.

### 3.3 Principle III

*Openings should be large and multiple, while accommodating large shade structures that aside from shielding the sun during the warm period, protect walls and windows against precipitation damages. [3]*

■ A - Traditional Fabric

Large, multiple openings can be seen on the upper story (exterior elevation) and on both stories (interior elevation) that mostly stretch up from floor level, thus allowing for airflow at this level. All vertical elements of the envelope are protected from precipitation under the broad roof eaves or under drip caps. (Figure 6 - left)

■ B - Semi-compact, Low-rise Fabric

Window sill height from floor is about 40-50 centimetres, allowing for airflow at the level of a seated person on the ground. In some refurbished houses with a more modern lifestyle of residents, this height is a little bit higher (40-60 centimetres from floor) to accommodate airflow at the level of a couch-seated person. (Figure 6 - right)

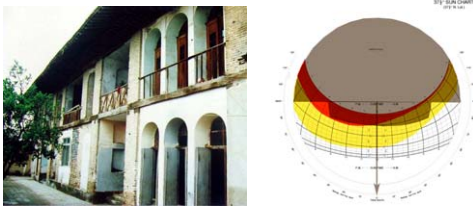


Figure 6. Multiple openings with appropriate shading mask [7 & 8] prepare natural light and ventilation.

■ C - Semi-compact, High-rise Fabric

Window sills are normally placed 70-80 centimetres above floor level, missing a sunshade most of the time.

■ D - Compact, High-rise Fabric

Windows are small in size, often missing a sunshade, and have metal sash. Except for glazed doors that open onto balconies or patios, the window sill is placed at a 90-100 centimetre height from the floor. (Figure 7)



Figure 7. bad designs and bad shading masks, cause glare, summer overheat and winter heat lose.

Studying the architecture of Gorgan through different periods shows that its traditional architecture corresponds a great deal with local environmental and climatic conditions, and its methods provide an appropriate solution to the comfort needs and climate disturbances. Studying and climatically analyzing the contemporary architecture of the city, however, shows that particularly during the last two decades, architecture has drawn away from vernacular compatibility with climate. Especially in apartment blocks climate control concerns have essentially been overlooked. Houses are missing a proper amount of daylight, sunshine, airflow and view. Sadly, this type of construction has been promoted mostly by governmental institutions and organizations.

#### 4. Guidelines for Climatic Design

A review of construction types from past to present displays an architecture that has gradually drawn incompatible with local climate. The question now is that is there any way of climate-compatible design that would also suit the needs and tastes of modern life, offering a more human and more intelligent architecture?

Among contemporary studied cases that were either relatively recent or under construction, there could be found examples that although modern and contemporary, were also climate-sensitive in design. The aim has been to analyze them with regard to their pros and cons, with recommendations as to how to overcome the deficiencies. Quite acceptable cases were studied that not only were their designs modern, stylish and up to current demands, they also applied climatically correct principles and guidelines that practically have made possible a suitable and high-quality architecture. (Figure 8)

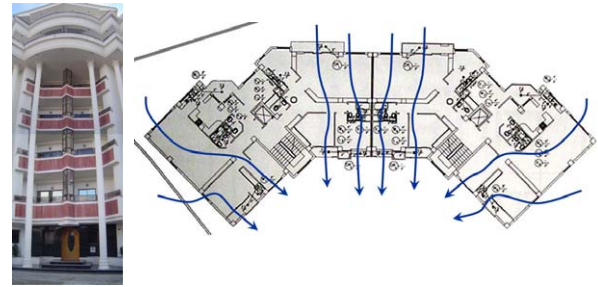


Figure 8. A recent architecture sample of climate-compatible design

The following provides climate-compatible design principles and guidelines applicable to city fabric, building complexes, and singular buildings. Basic principles are provided, such is the need for the planner from the conceptual to the construction document phase: 1. form, compaction, and position of the residential complex; 2. connection between open, semi-open, and closed spaces, orientation, interior arrangement; 3. placement, add-ons, shades of the openings, materials of the windows; 4. thermal transmittance, thermal insulation, vapour barrier and drain of the envelope. By applying these guidelines, we can create an intelligent, more climate-compatible architecture in the region. A few of these guidelines according to the three mentioned principles are as follows:

##### 4.1 Guideline I: Compaction—Mass and Space

► To benefit from breezes, the minimum spacing of buildings should be 2 to 2.25 times the height of the wind-facing building, given that the length of its windward side does not exceed twice its height. (Figure 9, down)

- ▶ Minimum spacing on the southern to south-eastern sides should be 2 to 2.5 times the height of the southern building. (Figure 9)

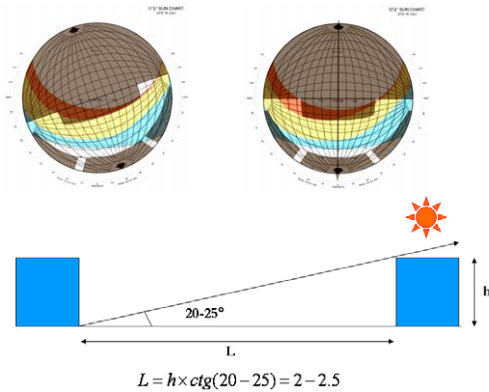


Figure 9. A reasonable compaction of fabric design

- ▶ In the case of more compaction required, building blocks can be spaced more densely on their eastern/western sides, or even attached.
- ▶ Some spaces should be considered between building blocks to allow for air movement, either in the form of narrow spacing between east-west attached blocks, or in the form of an un-walled ground floor for some of them. (Figure 10)



Figure 10. Spaces between buildings for air flow

- ▶ If the blocks are to be high-rise, rowing them up in a linear manner should be avoided, unless minimum north-south spacing is observed.
- ▶ It is best for an array of building blocks, particularly high-rise blocks, to be placed at intervals in both directions. This way, we can take advantage of natural lighting, solar heat, and breezes in spite of more density. (Figure 11)

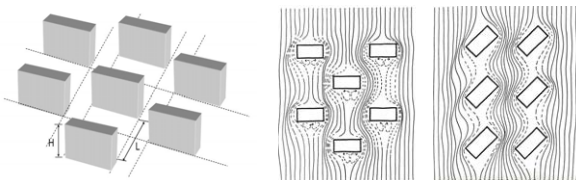


Figure 11. A reasonable compaction of fabric design to benefit of wind in all directions

#### 4.2 Guideline II: Semi-open Spaces

- ▶ Total open space area should be equal or greater than the total closed space area.
- ▶ Semi-open spaces should be considered as living area adjoin closed spaces either on one, two, three, or four sides.
- ▶ Living rooms (or part of them) are best to be planned as comprising both semi-open and closed spaces.
- ▶ Main living areas such as the living room, reception room, bedrooms, kitchen and their related semi open space are best to be placed in the southern or northern sides to enjoy daylight and natural ventilation. (Figure 12)

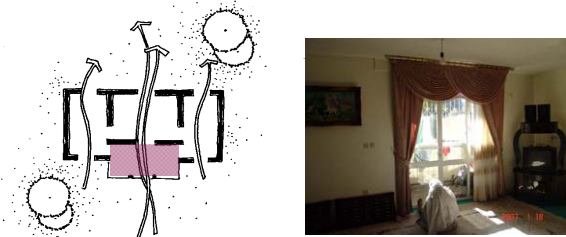


Figure 12. Semi open space beside living room

#### 4.3 Guideline III: Openings

- ▶ Entrance to the building should be located in the leeward side of the building as to avoid the cold westerly winds. Planning a double-layered space (an air trap) in the entrance area helps reduce loss of interior heated or cooled air.
- ▶ In order to have cross ventilation in the desired movement pattern, form and placement of windows shall be examined. (regard to pressure and suction areas)
- ▶ In order to avoid heat transmittance through western and northern windows that face cold and chilly winter winds, protective shutters must be installed on them.
- ▶ Air inlet and outlet sizes should be large, and where possible at least for the inlet, they should be extended from floor level. Inlet openings should be larger and distanced as away as possible from outlet openings.
- ▶ Horizontal louvers, roof overhangs and roof parapets can be utilized.
- ▶ Oblique shading devices or roof overhangs that shield the façade from catching sun rays should be installed. They should have a drip to prevent rainwater from reaching the facade or move towards the inside of the window.
- ▶ Horizontal shades had better be grilled, while also maintaining a distance from the exterior surface of the wall.
- ▶ South- and southeast-facing (+30°) windows shall have horizontal shades extending outward 0.4-0.45 times the height of the opening.
- ▶ Shades should be lengthened equal to the opening's height on either side of the window.
- ▶ Creating continuous balconies with the mentioned properties on this side of the buildings can be a favourable solution. (Figure 13)

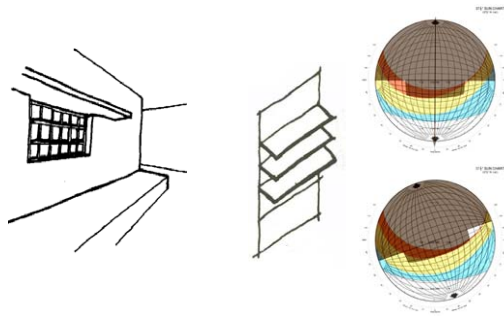


Figure 13. Shade devices of south and south/east openings

- ▶ North and northwest-facing ( $-30^\circ$ ) windows shall have vertical shades on their western side, one-half to one times the width of the opening deep. Unroofed balconies on this side of the building with a parapet wall on its west that would also shield chilly, cold winds and westerly slanting rain is a climatic design solution.
- ▶ East and west facing windows shall be omitted. If necessary, they shall be equipped either with horizontal sunshades deep about one-third of the opening's height, or with moving shading devices, protective shutters, external louvers and etc., to avoid morning/evening glare and westerly slanting rain.
- ▶ When in south/north street, the buildings in the west side are higher than the buildings in the east, the windows toward west, need only moving shade devices or small roofed porch. (Figure 14)

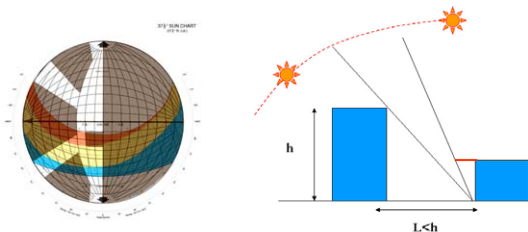


Figure 14. Arrangement of buildings beside a south/north street to avoid glare and overheat of west façade

- ▶ When creating fins or horizontal/vertical window shades, pressure and suction areas around the openings, plus the distribution pattern of inside airflow shall be considered. (Figure 15)

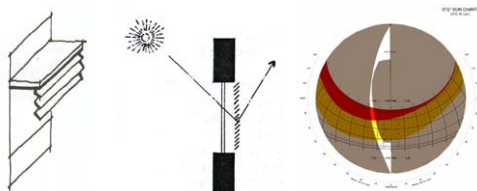


Figure 15. Moving shade devices of east/west openings

## 5. CONCLUSION

In view of the present cultural trends and the essentials of modern life, there is need for formulating practical and popular climate-compatible residential design guidelines. To achieve this, simultaneous consideration of climatic conditions and the changing lifestyles is a must. Therefore, according to the needs of an architect from conceptual to construction document phase, basic guidelines have been provided.

It must be considered that these guidelines have been prepared only according to climatic and environmental concerns, and they do not correspond to other matters of design such as economy, aesthetics or function which contribute to the overall architectural plan. Because of the multiplicity of these variables, climatic guidelines have been prepared so as to be flexible enough to adapt to a variety of conditions. For example, acceptable building orientation has been introduced as to range from the south to the southeast direction, but shall be minutely determined by the architect according to other concerns such as site properties, access, slope, views, privacy and etc. Also, only the general form and proportions of window sunshades have been offered, while material, type, and size are left for the architect to properly and effectively select and design. Observing these principles does not limit architectural design, conversely it contributes to it forming and becoming meaningful.

## 6. ACKNOWLEDGEMENT

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