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The Effect of External Openings in Buildings in Reaching Man's Thermal Comfort

Sameh Mohamed Hamed,

Thebes Higher Institute for Engineering lecture in architecture Engineering department

***Corresponding author*: Email address**: sameh.mohamed@thebes.edu.eg

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ABSTRACT

Natural ventilation is one of the important elements for creating a suitable healthy environment. It provides thermal comfort in buildings. However, the rising building densities and the high prices of land led to an increase in residential densities. Hence, high buildings appeared which obstruct natural ventilation and natural lighting and hinder the air movement around and inside the buildings there for, the need arises for studying problems stemming from opening in facades and the air movement outside and inside the buildings in order to reach natural ventilation for people's comfortable inside the building. The present research discusses the idea of developing styles of architectural designees and exploiting modern techniques in design in order to increase effectiveness of natural ventilation through designing opening in facades in light of the phenomenon of climate change. In this research, the residential building was analyzed, ventilation was studied. Measurements were made. The research followed the analytical method for architectural elements to employ them, Such as the internal courtyards, The wind-catcher, places of openings and their measurements as well the building direction to achieve man's thermal comfort inside the building.

KEYWORDS*:* natural ventilation, thermal comfort, architecture elements, climate change.

1 INTRODUCTION

Man's comfort in his residence is affected by a number of factors, major among them which are climate factors such as temperature, humidity, air movement and solar radiation. With the rapid growth of the sector building services, man's sought to ensure thermal comfort in contemporary residence by using modern mechanical means represented in air conditioners which lead to an increase in using energy. In addition to economic burden and health damage, natural ventilation inside the building is considered one of the most important axes of good design of buildings. It lessens exploiting energy and helps ensure a healthy atmosphere suitable for man. This is the role of the great designing engineer to achieve thermal comfort to man as far as possible, a subject which will be dealt with in this research, with shortage in energy at the world, there appeared the need to codify uses of energy in buildings in the two processes of cooling and heating. This energy represents a high percentage of the rate of consumption in other sectors. Hence began the direction towards thermal leakage through walls and surface ceilings, external openings in facades, and quality of building materials. The need to limit the use of energy in buildings arose. Among the solutions suggested to reduce the use of energy was to limit, The flow of heat through the buildings outer cover by good thermal isolation. Natural ventilation helps thermal movement from and to the building, which calls for the study of region's climate and climate's nature since they have a great effect on the movement of air inside residence. This is as well as employing this fact for man's thermal comfort. Here, the research concerns itself with study of design and environment to employ one of the men's of comfort, namely natural ventilation and designing openings of facades to reach the movement of air inside spaces to effect humidification of the residence and reach a thermal comfort suitable for man to practice activities inside the building, save energy and help in natural climatic treatments.

2 STUDY AIMS

With a view to the importance of supplying architectural spaces with pure, healthy air and renewing the air inside them we have to be identify with methods and styles of ventilation, in all its kinds in architectural spaces. The study, also, aims at inspecting elements which affect comfort in buildings.

3 STUDY PROBLEM

The problem of natural ventilation has aggravated in later years due to the rise in population densities and the rise in land prices, which led to an increase in the number of floors and consequently building density rise and informal housing, spread this had its effect on natural lighting and natural ventilation with necessitated turning to mechanical ventilation and an increase in energy consumption at a time problems appeared as a result of energy depletion. This led to thermal retention resulting in an increase in temperature.

4 HYPOTHESIS

Natural ventilation has greatest effect on achieving a healthy environment which achieves suitable thermal comfort and reduce humidity to buildings users. It also decreases the amount of consumed energy, to prove or disprove, previous hypothesis, the following points were taken into consideration according to a number of level:

-The effect of architectural design of items of residential building on natural ventilation in doors.

-study of proportions of opening in facades and their impact on air movement inside the residence.

-study of the mechanism of air movement in residential models and comparing the results.

5 RESEARCH IMPORTANCE

- Creating a suitable healthy environment for users through ensuring a comfortable atmosphere.
- Rationalizing energy consumption through reducing the use of mechanical means and air conditioners.
- To reach modern technology with results suitable for natural ventilation.

6 RESEARCH OBJECTIVES

The research aims to create suitability between the residence building and the surrounding environment through:

- Elucidation of the relationship between the concept of architectural design and its impact on natural ventilation.
- Study of the impact of direction on the natural ventilation on the residence.

- Recognizing the effect of the Heritage architectural elements such as wind catchers, mashrabiyya, the inner courtyard and landscape to pronating thermal comfort inside the building.
- Studying opening in facades and their effect on directing air movement.

7 DEFINITIONS

7.1 Definition of ventilation:

It is defined as the process of removing of adding of renewing air whether by the natural of mechanical way, changing the air in the building is considered extremely important for removing any smoker odors of dust hanging in the air.

-ventilation is defined as providing pure air constantly either through using natural of mechanical ventilation. ventilation may be general of objective or both. Ventilation is also defined as effecting air movement in the specified place with renewing the air by outside air to ensure that the atmosphere is suitable for man from the thermal and health points of view.

7.1.1 Negative and active natural ventilation

It is reducing the concentration of emissions and odors, and Lessing temperature through conduction in case of continuous ventilation and through evaporation in the process of humidification when air temperature increases to be more than the rate of thermal comfort. Natural ventilation depends on the natural air movement (wind)under the influence of the natural pressure of wind speed of accumulative effect resulting from thermal variation (ventilation of accumulative effect). likewise, negative elements affecting air flow like site circumstances, building mass, opening in the building to draw wind or drive air outside the building.

7.1.2 Negative architecture is the natural architecture which suits the environment of bio-climate

Architecture, which is negative in energy consumption, it is the outcome of traditional architecture in different environment coupled with comfort and suitable for survival through willful adjustment to climate problems, depending on natural energy without consuming the traditional fossil energy.

7.1.3 Definition of climate design

Climate design is one aspect of the process of designing the built environment. It is concerned with providing climate circumstances that are safe and comfortable for man at the lowest cost. Climate design aims to achieve the thermal comfort suitable for space users. This is because thermal comfort has direct impact on activities occurring inside the space users in performing activities and their efficiency in production. Besides the uncomfortable position, lasting for a long time many causes health and pathological risks the simplest of which are externs' nervousness and the social problems it may cause. It may cause, also, loss of concentration which, in its turn, causes accidents, injuries and low product.

7.1.4 Definition of thermal comfort

-Thermal comfort region is the thermal limit where man's feeling of comfort is restricted. This thermal limit differs with the difference of circumstance of the climatic environment surrounding man with regard to temperature, solar radiation, relative humidity and air velocity. They differ with the difference of geographic site. Feeling comfort able in hot areas depends on some factors. These factors are reducing thermal flow by connection, delaying the time of thermal flow, improving ventilation, reducing thermal gain from solar radiation, cooling the general atmosphere.

-The American society of warning, cooling and air conditioning engineers defines thermal comfort as a state of mind when a person express comfort in his thermal environment.

-Thermal comfort is defined as a psychological state when a person feels satisfied with circumstances of the surrounding environment. Thermal comfort can be conversely defined in sense that a state when a person feels neither cold nor heat or feels any annoyance us an environment.

- Thermal comfort may also be defined as the state of the central psychological system which leads a person to feel satisfied with the environment surrounding him physiological comfort is defined as a feeling which comes over a person and makes him feel absolute psychological comfort according to certain climatic and natural circumstances which he wishes to last without any increase of decrease. Thermal comfort is defined as the state which occurs when keeping the body temperature within 37 without exerting any effort leading to perspiration of disturbed muscle trembling. Then physiological state happens when man's central psychological system is exposed the smallest amount of external environmental, surrounding effect.

In this state, burden on man's body's temperature organizing system lessens, like organizing the work of blood vessels, perspiration and acidification ,the process of oxidation in the process of obtaining the desired thermal neutralization.

Some studies aimed at finding one criterion of indicator which expresses all different variables such as temperature, relative humidity and air speed. This is by representing thermal comfort area on one of some curves which the effect of different impacts is fused such as thermal comfort map drain by victor olgay as shape (1) and dropping the climate circumstances elements of any space on the curve. Here we can decide it this space falls inside or outside the range of comfort. Thermal comfort map includes a vertical axis of thermometer's dry degrees and another horizontal axis of relative humidity. the optimal thermal comfort region was determined between 22tempreature and 27, and relative humidity from 30 to 60%.it extends to 77:81%as appears in figure no 1 this map is valid for dry and humid hot regions and the ordinary person with moderate activity and clothes equaling 1 alloy.

7.1.4.1 Indicators of thermal comfort

Indicators of thermal comfort point to indicators of resulting from the relationship between performance, man's body, and the feeling of thermal comfort.

7.1.4.2 Building thermal performance

Building thermal performance is to what exert the building design, in its forms outer envelope and elements, responds to variable climatic circumstance all the year round. What is meant by efficiency of thermal performance is the optical relationship between the building design and its thermal performance and to what extent this affects reduction of energy consumption to reach thermal comfort.

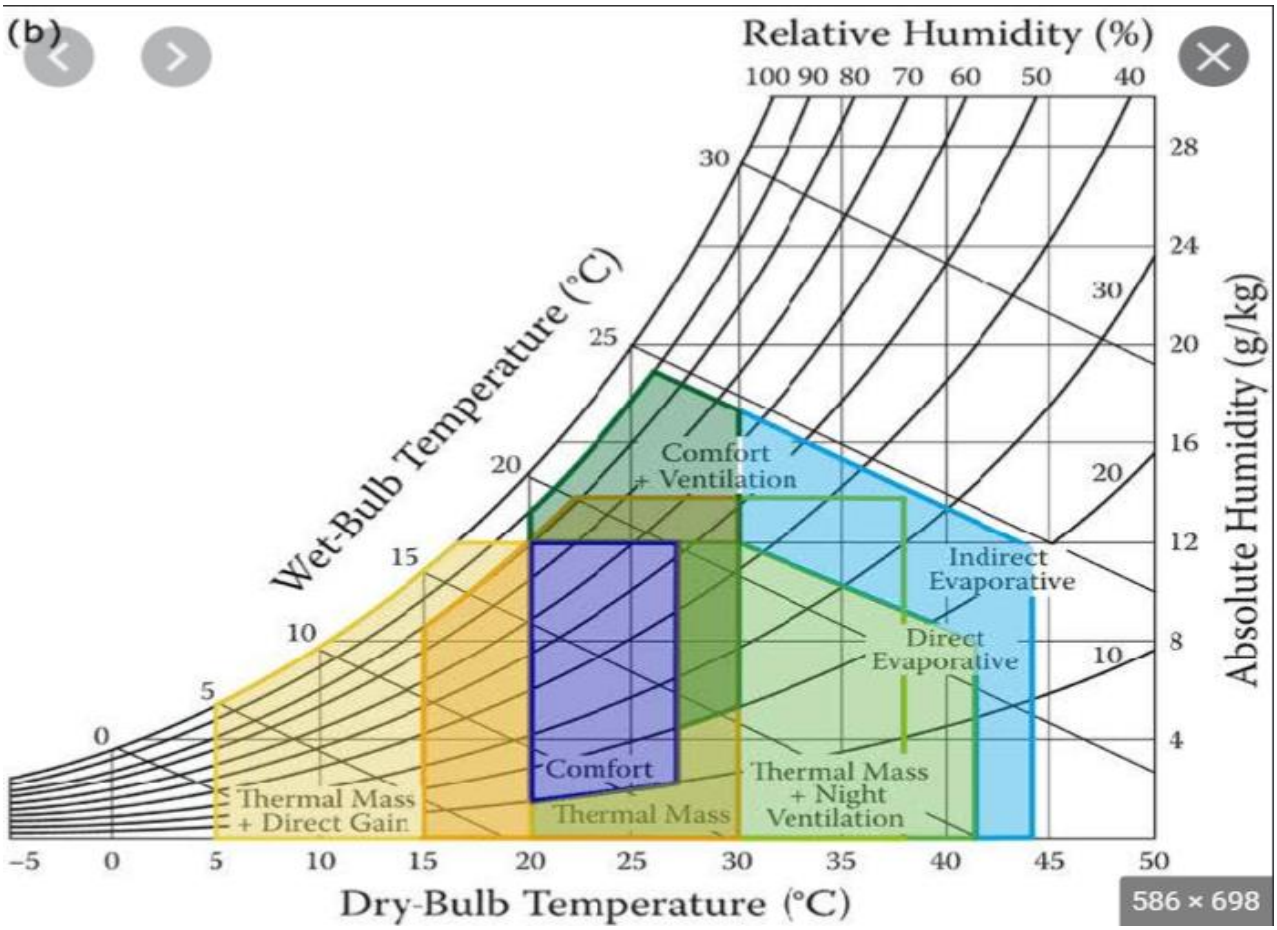

Figure 1: boundaries of thermal comfort region according to comfort map of victor oligay

8 VENTILATION OBJECTIVES

Ventilation aims to achieve thermal comfort, it which is feeling comfort in the surrounding atmosphere which allow a person to get rid of excessive temperature and humidity which constantly result from metabolism inside man's body. Humidity aims to get rid of many pollutants found in the air which have harmful effects on man's health and comfort, since the agency of environmental protection indicated that air pollution inside spaces is 70% more than pollution in buildings, which affects the quality of inside air, include:

- Temperature and vapor arising from inhabitants of the place.

- Consuming oxygen in a chemical interaction is like ignition.
- Temperature resulting from equipment inside the place.
- Excess humidity from air processes occurring inside the place.
- Undesired odors.
- Bacteria and soil reproduction
- Presence of many gases such as first Carbon dioxide, volatile organic compounds, and minute, molecules' which are harmful to health. Ventilation also aims to: (minimize heat, humidity and coldness, protect against fire and explosions).

9 VENTILATION INSIDE ARCHITECTURAL SPACE

Ventilation inside architectural spaces is divided into two kinds:

9.1 Natural ventilation

9.1.1 It is reducing, concentration of emission and odour, reducing temperature through conduction in case of continuous ventilation and evaporation in the process of humidification when air temperature increases over thermal comfort rate and heating through convection as well.

9.1.2 Rates of natural ventilation required for thermal comfort

Levels of it flow, speed and homogeneity depend on space on the surface of openings of entry and exit of air, their position and direction ,as well as on space volume increases when the (place of opening –the way air flow-internal and external temperature).table 1 shows levels of required ventilation for different spaces.

Table 1 ventilation levels required for different spaces

Kind of internal space	Level of required ventilation per person m/h/person	M2Space surface/m3/h/m2
Open area-stores, halls offices	18-29	3

Residential,administrative,education building,resteraunt and stores	29-43	4.6
Kitchen,bathroom-residental units	60-90	36
Public places, meeting room	57-90	21.6

BSI, British Standards Intention: code of practice for designbuilding.p.16

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9.2 Factors affecting air movement:

In the general site and inside the building showed that air moves affected by:

First: Forces of wind pressure are the variation in air pressure resulting from differences in wind speed since air flows from the area of high pressure (the positive) to the area of low pressure (the negative).

Second: thermal forces are the movement of air by convection effect which is the effect of the difference in temperature like what happens in chimney effect when the hot air with less density to be replaced with colder denser air.

Elements which affect air movement by the difference in wind pressure can be divided as follows:

9.2.1 The layout and its topography, wind *speed increases when we rise above the earth service. Wind speed at ten meters' high is evaluated as its double speed when it is at a height of half a meter because of surface obstacles'***.**

9.2.2 Plantations in the layout

Wind speed decreases by 60-80 % after its permeating of an area of dense pinewood by 30 meters to become 50% after 60 meters and becomes 7% of its original value after 120 meters. If the trees are high, wind direction changes after a distance of five times the height of trees. They don't return to touch the earth until a distance of ten times the height of the trees

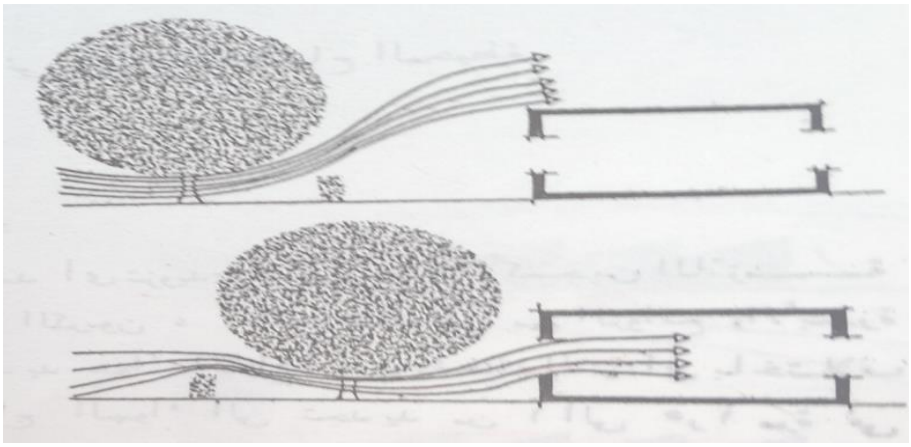
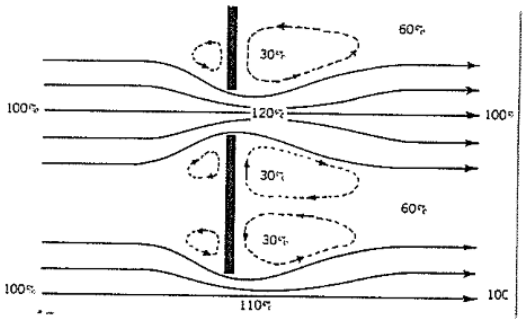


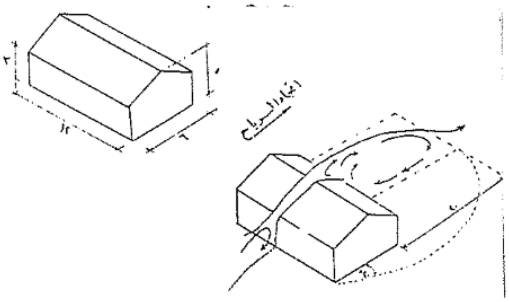
Figure 2 exploiting trees in dragging air inside the building

9.2.3 Pattern and height of building

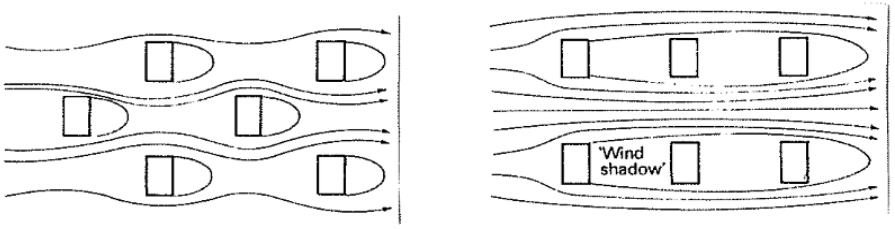
Urban fabric effects of building which permeates fabric spaces, and directing its movement and temperature. pressure of winds falling on surfaces of the separate mass varies. adjacent contiguous and monolithic blocks, exchange ally or in Parallel rows, affect increase of decrease of the area of wind shadow where air low and speed decrease (figure 2)



A-wind speed in the area of wind shadow equals 30-60 %

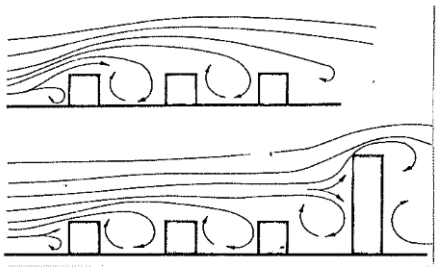


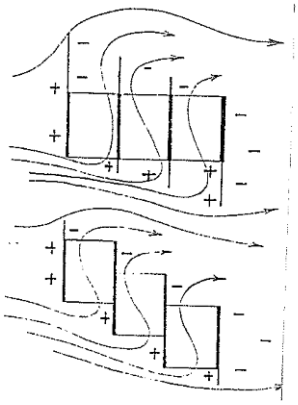
b-wind shadow area equals five times the height of the building(1)



c- the staggered reduces the area of Stagnant wind

d-wind areas shadow for air to reach the second row (wind shadow) wind permeates the building , the distance between it and the first row equal six times The height of the building in the first row.





e- a reverse return current of air occurs when winds Collide with a high building its severity increases as the building becomes higher. Likewise, the area of wind shadow behind current heading to inside the space The vortex flow increases behind the lower buildings and the swirls increase in front of the taller buildings

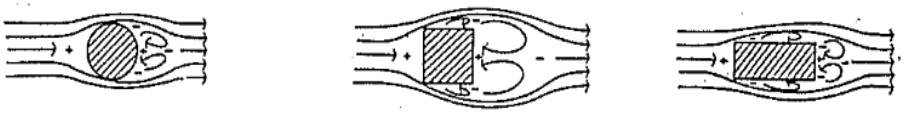
f- wind can be transferred at an angle of 90 in, attach of pattern or by increasing the surface of external walls.

it increase around the building walls which separate the units that cause an air

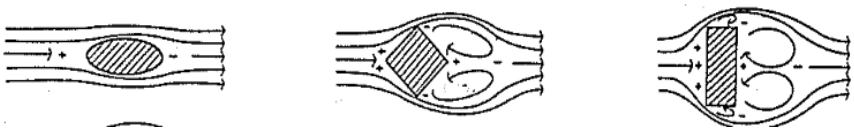
Figure 3 exploiting the effect of urban fabric on air movement

9.2.4 Shape and direction of the building mass

Anybody in direction of wind movement causes vortexes which occur according to wind pressure and shape of the body of building as shown in figure 3



Less exposed to the wind



Exposure to wind increases by turning to it

The building's roof and air movement

Figure 4 the effect of the shape of building mass on distribution of air movement.

9.2.5 Mass spaces and their positions

The movement of air inside the building is affected by presence of open sky space like sky courtyards and sky lights.

9.2.5.1 The courtyard (sky space)

The sky courtyard affects the improvement of climate internal since many researchers like Dunham, H. fathy, And Givoniarrived at a cone lesion about this which is that the building with the courtyard is considered the best, building to be used in the desert areas.

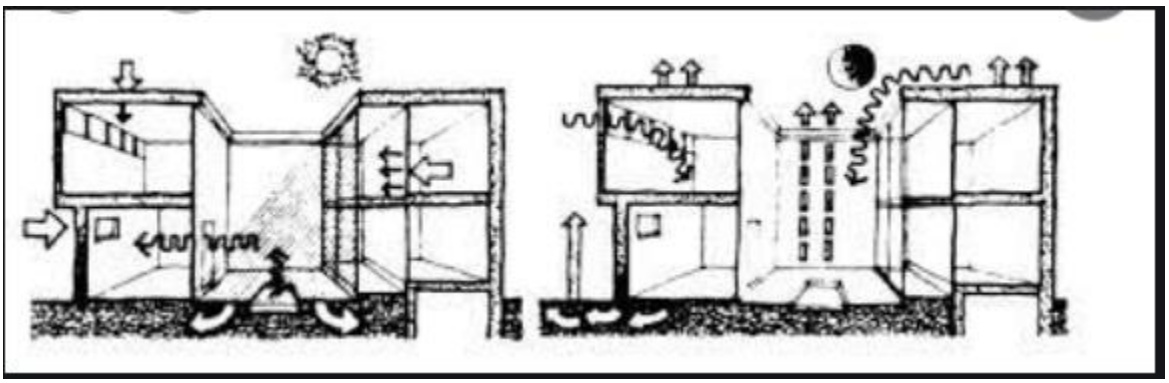


Figure 5 thermal behavior in the courtyard during day and night

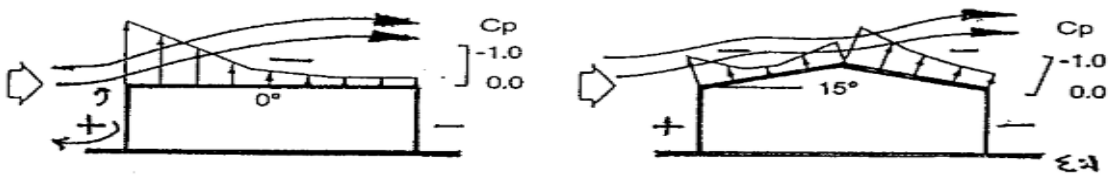
The courtyard is considered as a thermostat since it works the building. During night, with the first drawn breezes, the courtyard is filled with cold air which replaces the hot air which the sunrise and during the first periods of the day, the air outside the building becomes warm while the air inside the courtyard is cold. This is because shadows cover large parts of the courtyard ground, lessening the reflected solar rays of for the presence of green areas and the Fountains in these courtyards, which results in reducing fascinating, in density, lightening, air temperature inside it.and increasing humidity level we can benefit from this in improving the climatic environment of the building without using industrial means. The inner courtyard helps also in protecting the building from sand and dust storms and works as a strainer. this is in addition to providing greenery elements and water inside the courtyards alleviating the intensity of drought inside the building as figure 5 shows.

9.2.5.2 Wind movement around

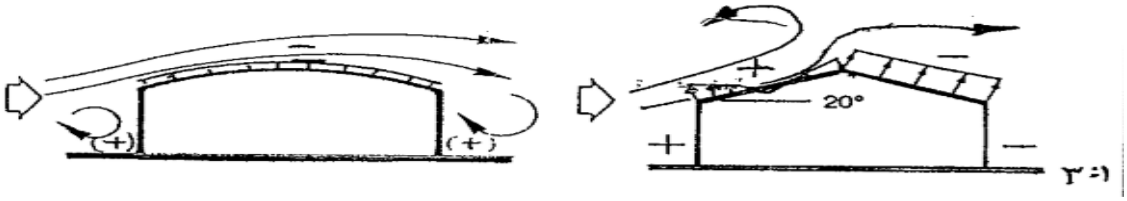
Wind movement a round and inside the building is affected by shape of the ceiling the sloping, the curved, and graded horizontal, the air movement also is affected by the shape and place of the ceiling openings either to catch air or drive it away from inside the building to outside, height of the ceiling affects type and speed of air movement inside the spaces.

9.2.5.3 Shape of the building ceiling

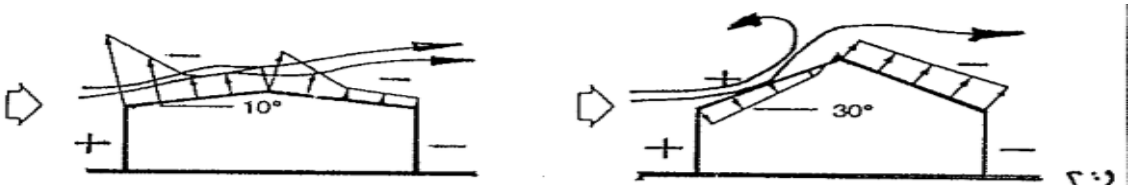
When the wind blows on a building façade it creates a positive pressure area wind words. the wind moves over and around the building where cloud areas are there (negative pressure). the ceiling begins to be affected by the wind when its inclination exceeds 15 degrees and the pressure increases. Pressure increases on it as the sloping angle increases and the area where air flows increases while wind slopes around the Vaulted ceiling ,the walls fall below it under positive pressure as in figure(5).as the horizontal ceiling is graded there exist areas of disturbed flow of surface height vortexes.in the region where the effect occur which connecting between the two level of the graded horizontal ceiling ,so the wind movement becomes active on the ceiling surface which decreases thermal pressure on it .



The horizontal ceiling which is sloping until angle 15 under the influence of negative pressure and the effect of the rotating flow zone is less when the letters



The vaulted roof moves the wind around the building, and the walls below it are under the influence of positive pressure

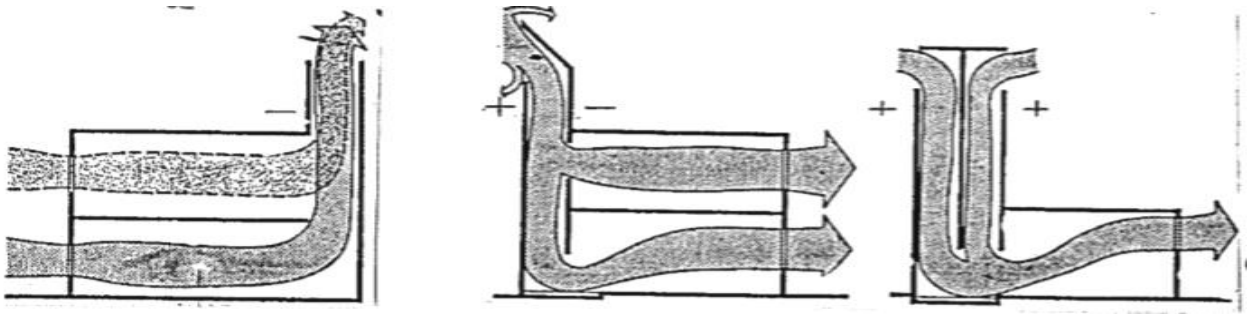


The greater the slope of the roof, the greater the wind pressure on it and the greater the rotational flow around the building.

Figure (6) The effect of the shape of the roof on the movement of air

9.2.5.4 Opening in the building ceiling

It is a space in the wall of the building connected to the outside by a skylight covered with a wooden cover sloping in the direction of the prevailing winds, and sometimes extends with a channel through internal or external building walls in Egyptian Mameluke architecture, the wind catchers were used to catch air by wind pressure as well dispel it in the Badger(Persian high wind towers)to they catch cold wind at night dismiss it by day by thermal effect as figure (6)

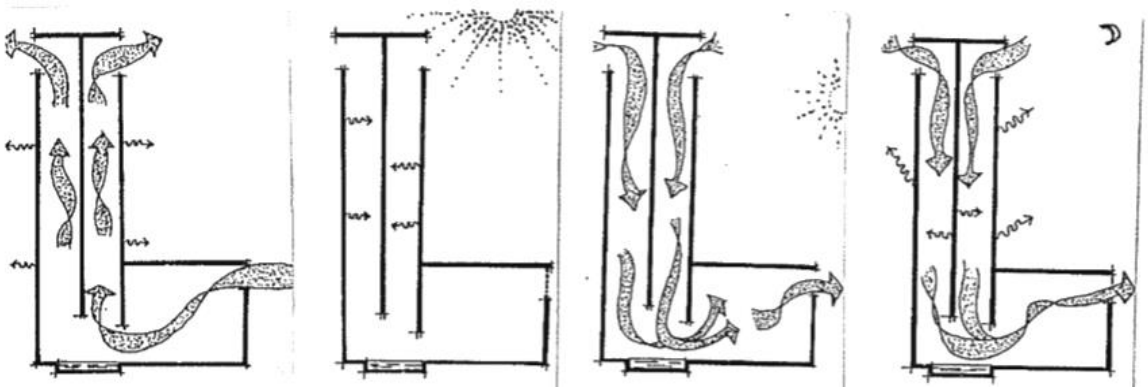


1-Upstream tower to discharge hot air 2- Downstream tower to catch the prevailing winds 3- Downstream towers to catch winds from any direction

1-Towers of the cold of descending current to catch the wind in any direction and to farthest thermal contrast.

2-Tower of pressure of descending current to catch prevailing wind (wind catcher)

3-Towersof as seeding current(anabatic) to dismiss hot air outside the space as a result of thermal contrast.



A-Air movement at sunset B- during the day C-at the beginning of the day D- Air movement during the night

Figure (7) Air movement inside a tower during a whole day

A-Pressure and density of the air adjacent to towers walls decrease it is pushed by outside air.

B-When walls of catch air begin to absorb sun heat, the wind is stop to move.

C-Outside air is colder than the inside air.it is drum because of connection.

D-At the night, walls of the wind catcher by cold radiation and outside air descend inside the space.

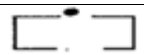
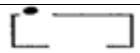
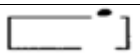
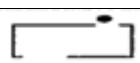
9.3 Wall openings

Natural ventilation through air openings depends on air movement according to its speed, direction and temperature ventilation, level in the space depends on the measurements and place of ventilation opening, permeated air moves to the space by force of dormant atmospheric pressure. It is the difference of temperature inside and outside or by force of the difference pressure. To decide places of air entry and exit, we have to be acquainted with the type of airflow inside the space either by the difference of atmosphere pressure or by force of wind pressure.

9.3.1 Places of ventilation opening in plan and direction of the wind

Places of ventilation opening in the horizontal projection, and direction of the wind falling on it. Air spreads inside the place at its greatest value when the wind is slanting on the ventilation opening. Table 2 shows the increate the maximum ventilation rate inside the spaces for wind slanting on the opening of air entry which faces on a slanting axis, the opening of air exit, the rate of air flow increases with site increase in the horizontal distance between axes of the two opening

Table (2) the effect of the place of entry and exit opening and the direction of a wind falling on rate of air flow

angle / opening	0°	15°	30°	45°	60°	75°	90°
	23.6	24.8	22.3	18	16.3	12.5	10
	25.8	23.3	22.2	17.8	16.7	12.8	8.3
	21.4	19.2	16.3	15.6	13.5	11.4	8.6
	22.8	26.7	25.7	24.9	20.7	11.7	8.9
	22.5	25.8	29	26.7	20.6	11.7	10.3

9.3.2 Places of the opening in the sector

The optimal ventilation occurs when we put the proportion of the sitting of ventilation. Air flow increases with the increase in widening the openings as figure (7) shows. The rise of the sitting in the living rooms is from -0.7to 1.2 meters, for classrooms, it is from 1.2 to 1.5 meters. In sleeping rooms at the level of a sleeping person it from -0.5 to 0.8 meters as figure (8) shows, Table (3). Illustration distribution of air velocity to different heights for different sitting, we notice from the measurements that the best velocity of air inside internal spaces occurs when the sitting is 0.9 m above the ground of the room's surface.

Level high	٠٫٥	٠٫٩	١٫٢	١٫٥
١٫٢٠	21.3	23.2	24.3	17.3
٠٫٩٠	22.2	25.5	21.2	14.1
٠٫٥٠	26.3	23.7	17.8	13.7

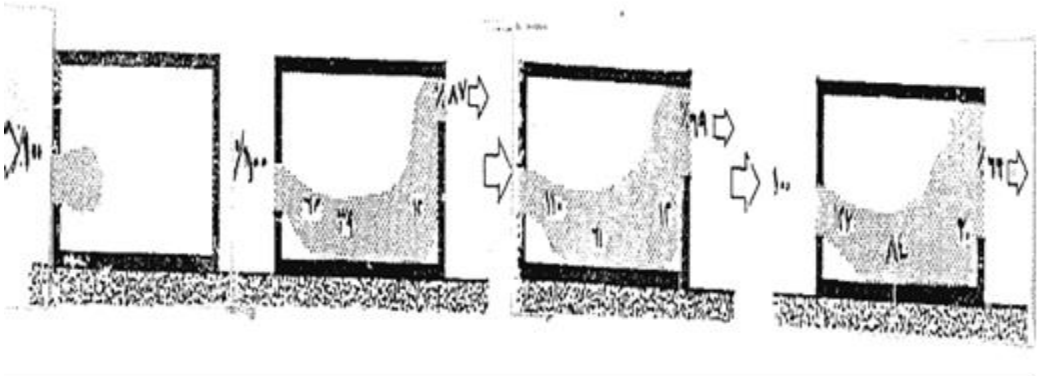
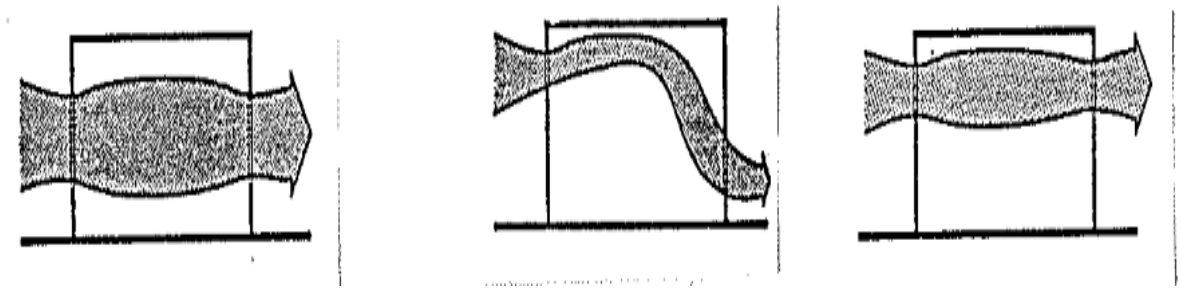


Figure (8) shows Measurements of air velocity in internal spaces, air velocity increases with the increase in exit opening more than entry opening.

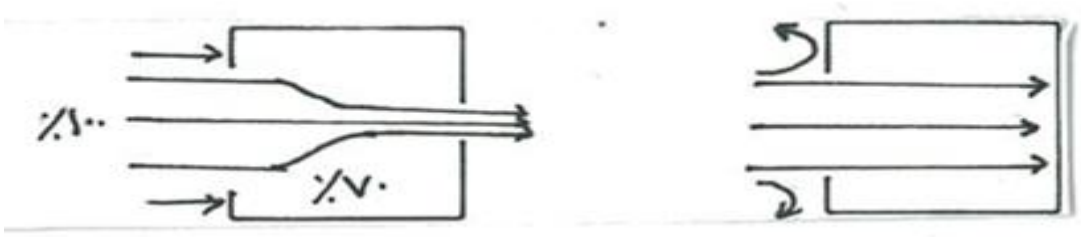


Ventilation desirable at the level of human height Ventilation is not required Bad ventilation higher than the level of human

Figure (9) shows Ventilation levels according to proportions the openings

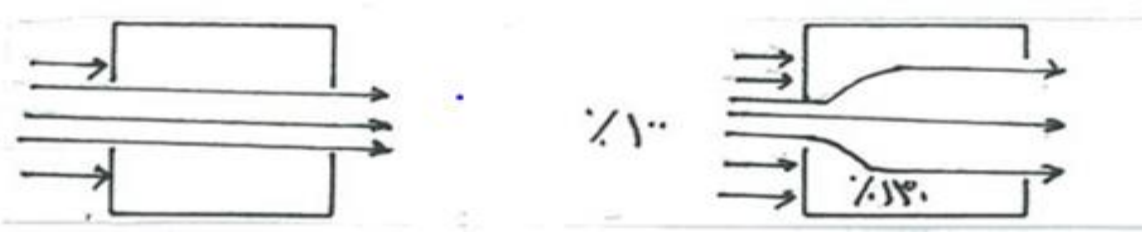
9.4 Size of ventilation opening air and exit opening

The wind dwells in the space with the single ventilation opening, no matter how large it is. Air flow speed increases by widening the exit openings. Air spreads in spaces. When the two openings become similar and force each other a swift disturbing current occurs. Ventilation level doubles due to the presence of more than one opening for constant ventilation figure (9)



a-the smallest indoor velocity b-

the exit air does not flow when the pressure is static.



c- maximum speed indoors than outdoors and noisy stream d- air is quicker and homogenous

figure (10) shows increase of wind velocity due to contrast in the size of entry and exit opening

10 The impact of the shape of ventilation opening on air flow rate inside the room

Rate of air flow to internal space increases according to the whole size of the window while sliding and pivoting opening reduce open space and consequently, the amount of air penetrating the space and the surface of ventilation opening required to change the air at the rate of time per hour by convection, which equals 5% of the surface of space floor openings are classified into :

- A big opening measuring 40 % -80% of flat room wall in humid areas where there are no cold seasons. Opening 20-40% of flat room wall.it exits in mild and cold climates to allow for thermal storage in winter.
- A small opening of less than 20% of external flat room walls.it is found in hot climates where the cold season does not last for more than three months to make it easier to shade.

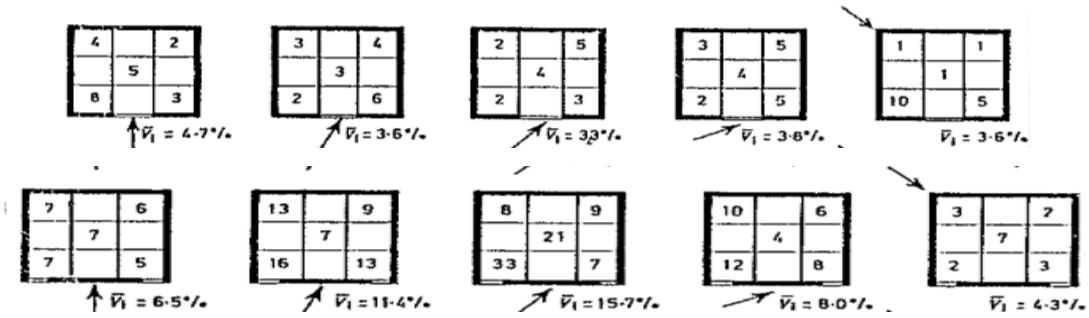
10.1 Top and wall openings and air flow rates.

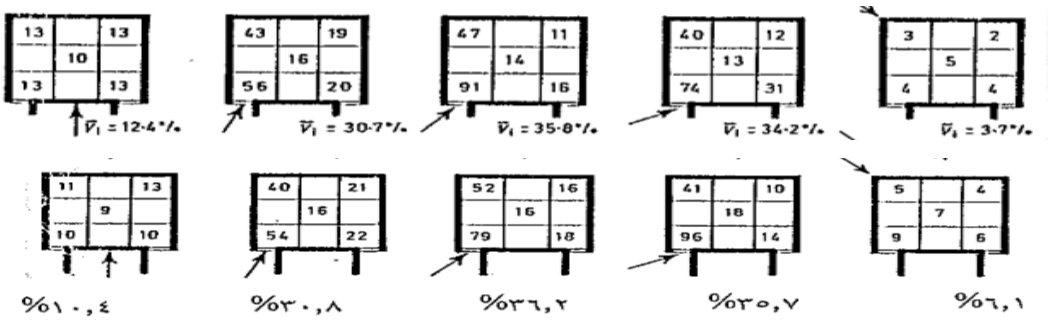
Upper openings like shafts and ceiling opening allows for continuous air flow inside spaces by driving a way, hot air collected up the room. outdoor colder air replaces it. rate of flow increases with the increase of the vertical distance between the openings and the internal beam openings, which allows for directing air flow, specify of vision and suspicion of calling abroad. Perforated panels “claustrum” work for increasing the pressure coefficient on the surface facing the windows. this increases the rush of air from those small and shaded openings to double its velocity

permeating the space, increasing the rate of velocity in the space. Air velocity allows for cooling. It also allows for preserving vision for space occupants.

- To create a continuous air current inside on room having an external wall, a single protrusion (from one direction) with two openings on the wall to let air in and out is to be made. The depth of the protrusion should not exceed half the distance between the protrusion and the end of entry opening and the other at the beginning of exit opening so that there are varied pressure areas to let a fare function area emerge before the arrival of air to the second opening. A pressure area from before the window near the wind from which air flows in while an area of pulling in front of the farthest window. Forms from which air flows out and an air current occults inside the room. The rate of wind velocity inside the space doubles when the wind is slanting on the building., Table (4) shows rates of air velocity inside the space compared to the free velocity in a room with one wall exposed to wind. (speed increases in the space with openings to which a vertical protrusion is attached).

Table (4) illustrates rate of air velocity inside the space compared to the free velocity in a room with one wall.



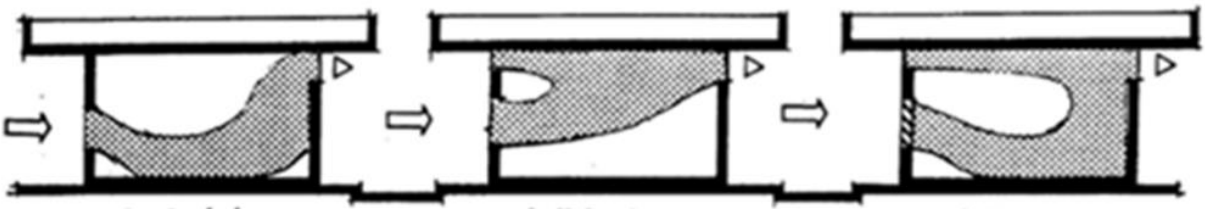


10.2 Internal coordination and the effect of internal separators on air velocity inside the space.

Internal separators reduce air velocity inside the space, as separators are reduced and penetrated by air, Air flow increases. while the opening of air entry and exit affect air flow velocity inside the space. they relationship with their wall separators affect, the direction of air and its velocity (figure 10). The optimal air flow inside the space occurs when the separators are free with openings for air to permeate in the case of being perpendicular on the wind. When the internal separators are in the direction of air flow, The air current continues in its course while spreading in the space. The effect of the internal joints obstructing the flow of air into the vacuum is reduced when the larger voids face wind entry.

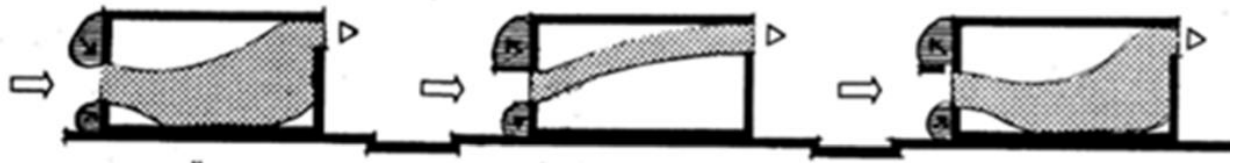
a- The internal separator directs the current up wards b- The internal separator obstruent's air spread

Figure (11) The relationship of entry and exit openings with the internal separate of affects air direction.



1- By arms

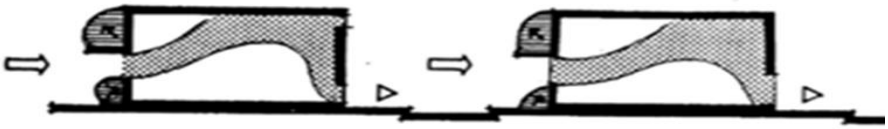
a-Low entry slot and one slot out loud b-Two holes for the air to enter and one hole for its exit c- the control of them by arms



2- By horizontal canopy

a-Without umbrella b- The canopy is attached to the wall with a longitudinal opening

c-The canopy is detached from the wall with a longitudinal opening



a-The canopy is attached to the wall with two openings b-The canopy is attached to the wall with one-hole down

c-The air is directed down and up by the pivot window

Figure (12) The way air flow is directed inside the room by using horizontal umbrellas and Pivot windows

Previous studies of the pattern of air flow on a model with incomplete separators (subdivisions) of different positions inside the space when air velocity was from 31 to 45 to showed that the lowest air velocity occurs. When the distance between the air opening and the separator decrease the optimal state for ventilation is when the separator is near air exit opening. Air moves through mass spaces as long as the connected spaces are open (figure 12).

11 Slot processors

Sun rays have a great effect on external openings in raising temperature of internal spaces over the temperature space users. The sun rays' movement, the angles and verticals, horizontal sun fall angles should be studied to decide the hours when the sun rays have a great effect on the window. Consequently, the design of means of shaping the window prevents the sun from passing through it. There are many means of shading external windows, most important of which are:

11.1 Sun breakers

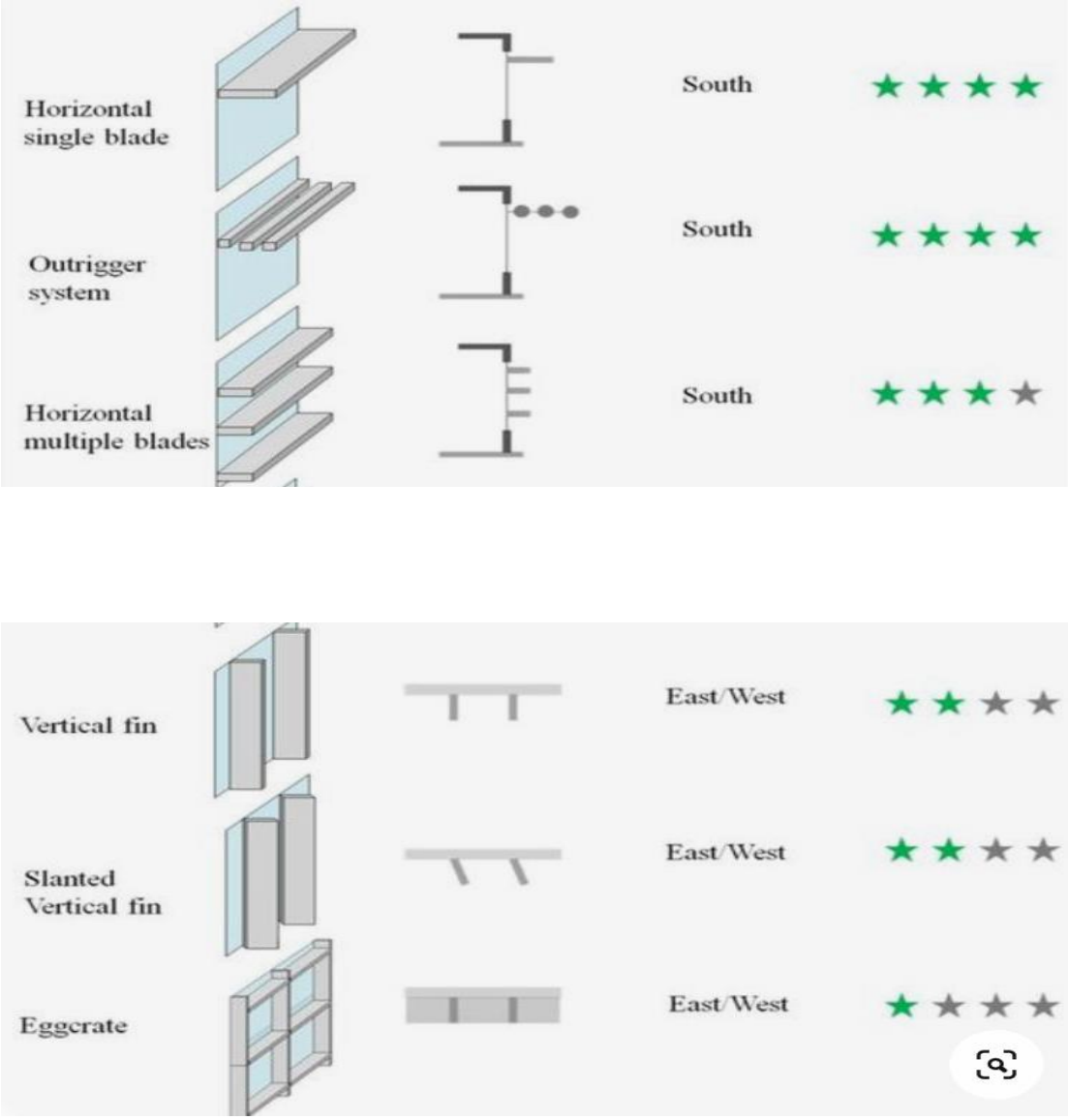
They are sun faces, either vertical or horizontal, to be installed in a vertical direction or a direction oblique on the façade. They are placed on the window edges or facing them in a way to shade it in the face of direct sun rays. To use sun breakers, we must define the place of sun site during the times when it needs shading, by using the sun path. Sun breakers are divided into two kinds as figure (9) shows.

11.1.1 Horizontal sun breakers:

They are used in particular in southern facades because they are exposed to direct sun rays in the period of mid-day. Angle of the sun falling is high in summer and low in winter in regions of hot, dry climate.

11.1.2 Vertical sun breakers

They are in eastern and western façades in areas of hot, dry climate. Since they are exposed to direct sun rays. It is better to use vertical sun breakers which move with some angles with the possibility of an inclination in north ward.



Figure(13) shown the horizontal & vertical breakers in facades buildings

11.1.3 Double sun breakers: They are usually used in south and south western facades:

11.2 Mashrabiyyas:

They depend on the idea of designing small, limited and repeated sun breakers on the facades horizontally and vertically in different aesthetic shapes. They are more distinguished from sun separators as follow:

-Their effect includes direct, scattered and reflected solar radiation., They are made from light material such as gypsum and wood. They have an attractive aesthetic appearance., they cope with the privacy which must be observed in internal space for users of buildings., they allow for distributing natural lighting inside the space in a gradual way from outside to inside.

12 Glass facades and their effect on thermal performance in buildings.

The process of designing glass facades is considered very important to achieve required objectives to have good thermal performance for buildings because glass facades work as an exterior envelope to save natural lighting and prevent solar radiation in summer and preventing heating internal space, while allowing it in winter for heating.

12.1 Thermal performance of glass facades:

Glass facades must reduce the passing of heat inside internal spaces in summer season, through: Preventing the penetration of direct solar radiation by different shading means of by improving and developing glass quality., Reducing glass radiation and preventing elements of glass facades to be exposed to heat either by preventing heat to reach it through outdoor air or by letting absorb part of the solar radiation to which it is exposed., Reducing transmission of heat by conduction across glass as a result of the difference in temperature between indoor and outdoor atmosphere., Glass facades have to increase heat penetration the indoor spaces in winter season by allowing direct solar radiation to the inside for a period of the day enough to raise temperature and reduce heating levels as well as disinfecting germs inside the spaces., Reducing the penetration of heat outwards in winter through lessening the penetration of glass to the infrared rays transmitted by the walls and hot objects inside the space and increasing the thermal insulation of the glass. Many researches sought to get the biggest quantity of required heat from solar rays through glass façades by developing techniques of glass facades, which allow for the use of low emission by adding a layer of Stable gas like Aragon between sheets of glass used, developing the framework around sheets of glass by adding Sealed insulators, besides it become easier to prevent absorbing heat by solar radiation through making sun breakers from low-emission glasslike mirror to reflect solar rays. The air layer between double glass sheets can work as barrier to prevent heat. Besides, some glass sheets have a membrane in between to reduce heat and allow the greatest amount of

light to pass and prevent harmful ultraviolet rays to pass, Big glass sheets also allow for the possibility of being installed from the bottom of the building to the ceiling, which provides natural light without acquiring heat.

12.2 Glass used for providing thermal comfort there are kinds of glass used for providing comfort, classified as following:

12.2.1 Appearance

Flat glass is one kind, it has some kinds, major among which are:(Float glass): It is used in places which need an ideal vision. It is characterized by great effectiveness in light transmission. It is used in many industries and applications of buildings, furniture and decors.,(Printed glass): Flat opaque or non-opaque colored, of patterned forms used in buildings, furniture and décor., (Colored glass): It is formed of layers which absorb sun rays and ultraviolet rays to control the strength of lighting, entering the building. Its use endless in facades and separators.,(Coates glass): It is glass covered with painting from transparent metal oxide which reflects solar radiation.,(Glass etched) with acid: It gives a maximum of lighting and privacy at the same time.it is used in internal designs in bathroom, offices and internal, external doors.,(Mirrors glass): it reflects solar radiation and Gives a sense of spaciousness of places., and finally (Printed glass): it provides beautiful shape on facades and achieves privacy.

12.2.2 Security:

It has many kinds:(Formed glass): it Shatter-resistant, used in present financial building.,(Heat strengthened glass): used in outside of high buildings., (Fire resistance glass) used in hospital, schools and commercial buildings.,(blended glass): contains addition which change its color, appearance and reduces its ability to transmit light And finally(tempered glass) it is characterized by its resistance to heat in buildings.

12.2.3 Performance(heat, sound, lighting):

It has many kinds which are:(insulting glass) it gives sound and heat isolation within 85% it is in schools, hospitals, windows and walls of broad casting, studios and recordings., (Galvanized

glass) it is works on controlling transportation of solar energy and sound isolation, therefore it is used in educational and security building., (double glass) it works to control solar energy and sound isolation ,therefore its used in educational and security building., it is glass which contains a hollow layers or gap between two sheets ,it is used to solve problems of glass known for its low thermal loss for each square meter.,(low emission glass) it allows for natural sun light and reduces thermal gain and blocks sun rays ,it used in all kinds of buildings.,(Acoustic glass)it is composed of two or more ordinary glass sheets, it works to control sun energy and protect against ultraviolet rays, It also adjusts the sound insulation and is used in airports and buildings in rapid public roads.,(Photosynthesis glass) it allows light to travel and allows light on the two sides .,(self -cleaning glass)it is characterized by easy cleaning ,it reduces penetration of ultraviolet rays.,(multi-reflective glass, it blocks infrared rays, reduces solar ray by 85 %,allows for desired light and achieves lighting.,(high definition glass),it is used to cope with the environment like transparency (seeing through glass from inside and outside)it presences energy and able to control solar rays.

13 The use of smart windows in buildings and it is impact on reducing heat on gain.

The idea of making smart windows to control passage of light and heat through it depends on one of the physical phenomena which respond to light like thermal optics, changing the color of light and liquid crystals, suspending particles screen and changing color by electricity. smart windows control the amount of required light when the need arises. The idea of smart windows is based on many technological means which depend on materials whose light properties change as regards absorption of reflection with a change in potential. This is through the use of minute difference particles able to absorb light. this method is called suspended particles. In addition, smart windows contribute much to reduction of energy. Consumption through its effect on reduction of direct heat gain and consumption of little amount of the electrical for its operation since it consumes a very small amount of the electrical energy required for its operation.it consumes what equals 0.6 w/f2 /A2. When the potential differences increases, the particles move randomly and do not allow the glass to let light pass.

14 RESEARCH RESULTS:

Identity is one of architectural requirements which must be taken into consideration in architectural design. identity in its different kinds is considered one of the most important requirement of work inside buildings and institution. It is considered one of the necessities which must be realized in architectural spaces especially the spaces which:

- It has humidity because natural air doesn't enter or enters in small quantities.
- Internal spaces don't get natural ventilation like Stores, corridors and underground floors ز
- Most of the technology of natural ventilation in Contemporary architecture and its applications dealt with problems of special ventilation in every climatic region, adopting developed means which vary according to climatic Circumstances of each climatic region.
- The appearance of developed Heritage architectural elements like wind catchers, cooling towers, and sun chimneys in hot and moderate regions.
- Design of openings and Contemporary natural ventilation systems which depend on modern technology achieved thermal comfort inside building.
- Development of materials and methods of insulating and upper sun faces from solar walls radiation contributed to limiting a heat leakage to the internal spaces of building.
- Reducing noise arising from the sound of air conditioned machines.
- Feasibility studies on the costal techniques of the treatment of natural ventilation are expensive in the short term but they are to save money in other respects related to thermal comfort.

15 RECOMMENDATIONS:

- Paying attention to coordinating internal courtyards and external spaces by cultivating them and supplying them with water.
- Narrow and small surfaces of external opening and directing spaces in wards by using courtyards

  , this is a solution with helps soften temperature of internal spaces.
- Seeking the help to other natural cooling means and using other architectural and design means to pull air inside the building spaces.
- Taking care of the lay out like the building direction, forms, and levels of openings to let air in and out in order to be able to control air flow velocity.

- Study of the effect of urban pattern on air velocity combined or separate.
- Study of the possibility of developing elements of Islamic architecture in ventilation, such as malkaf, mashrrabya, taktabush, makad, the seat and broken entrances.
- Paying due attention to required ventilation rates for different spaces
- Paying due attention to plantation in the lay out favorable winds as well as their distance between the building.

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