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Analysis of Using Window For Achieving Thermal Comfort In A Naturally Ventilated Building In Hyderabad Pakistan

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Abstract **Thermal comfort in work place is important for humans so that they can work efficiently.Natural ventilated building (office room) is designed to achieve thermal comfort during 8:00 to 18:00. To achieve thermal comfort, operative temperature is calculated by using window in a building room. The direction of West is best to place window in a building to achieve more thermal comfort hours.A room 2m x 1.5m with 3m ceiling height is designed to calculate operative temperature compared to ASHRAE general thermal comfort standard temperature 24^0 -26 ^{0}C during 8:00 to 18:00. Again window size has changed, the size is reduced and selected size 1m x 1m. The simulated results are again compared to ASHRAE general thermal comfort standard. From simulation it results that after reduction of window size thermal comfort hours are increased, the direction of West has highest thermal comfort hours of 41 for month June during 8:00 to 18:00 in Hyderabad Pakistan**

Index Terms**—key words:** ***ASHRAE Standard,Energy Plus Building Simulation,Natural Ventilation,Operative Temperature, Thermal Comfort,***

I. INTRODUCTION

During summer season most of the people concerning about the thermally comfortable zone in the hot climate region.

People determine natural ventilation in buildings for achieving thermal comfort inside dwelling buildings. It has been estimated, mechanical cooling devices such as an air conditioners, fans, etc. consume about 70% to 80% of the total building energy during the summer season in hot climate regions. [1]

Several studies have suggested that, one method of decreasing utilization of energy is to decrease an air conditioning demand. Architects and Builders should utilize their time in investigating the strategies based upon natural sources towards the best arrangement of less energy and natural climatic control of buildings. Rather than depending only on mechanical systems, so that mechanical devices could be additional systems. [2]

The ventilation provides suitable microclimate to building. Microclimate means the thermal environment as well as air excellence. The ventilated system design of a building or room depends upon factors i-e as they are elemental to thermal comfort and welfare of the human occupants or the concert of industrial processes within these spaces .People of recent cities use up over 90% of their actions in the buildings. It has been observed that thermal comfort is efficient and soothe in the school building. [3]

A. FUNDAMENTALS OF NATURAL VENTILATION:

Natural ventilation in buildings is defined as the air flow throughout the construction propelled by change in pressure naturally produced.

These pressure changes, or driving forces, are mainly two: Wind pressure and buoyancy.

B. WIND PRESSURE:

Is defined as the wind incidence onto a building façade at a certain velocity and direction. Fig.1 shows natural ventilation due to difference of pressure. Wind strikes to front of building with a positive pressure, a negative pressure occurs on opposite façade of the building.

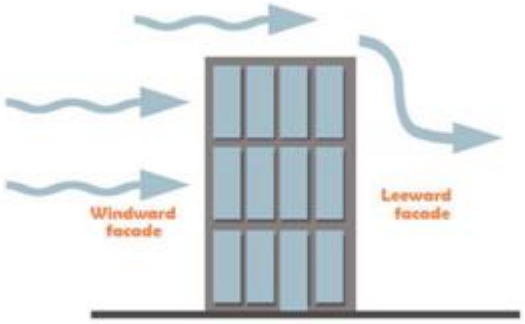

Fig 1Natural ventilation due to difference of pressure

C. BOUYANCY:

Is defined as the air density difference between indoor and outdoor air bodies caused by difference in the air temperature. but flow could occurs in horizontal direction as shown in fig.2

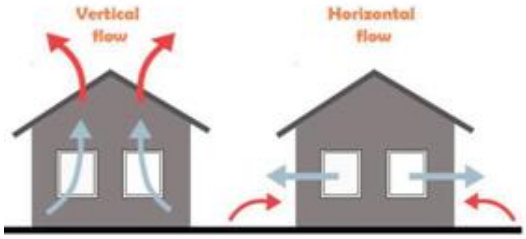

Fig.2 Natural ventilation due to difference of temperature

II. METHODLOGY:

A. MATREIAL AND METHODS:

A room is taken into account for thermal performances of a natural ventilated building. The site location of a building taken in this research work is situated in Hyderabad, Pakistan as shown in fig.3

Fig.3 site location Hyderabad

B. The following is weather data of Hyderabad

TABLE I: weather data of Hyderabad

Longitude=68.42^0	Time zone= +05:00 hr
Latitude=25.38^0	Elevation=41m

III. MODELING OF BUILDING:

The building envelope is modeled through Energy plus software. As given fig.4 below. And the description of building is given in Table:II below

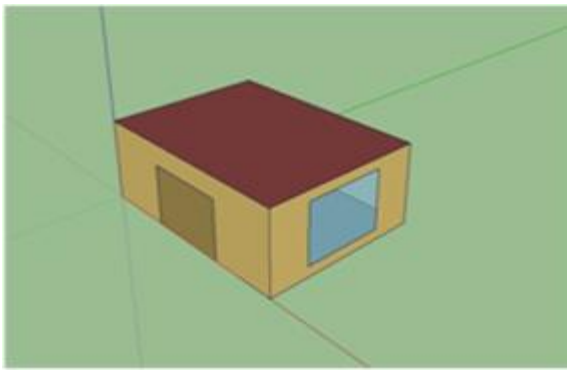

Fig.4 A single zone building model

TABLE.II Description of building model

S:no	Field	Size	Unit
1	Location	Hyderabad	-
2	Longitude	68.42	Degree
3	Latitude	25.38	Degree
4	Elevation	41	*m*
5	Time zone	+05 GMT	Hour
6	Building type	Single zone	-
7	Orientation	Sun exposed	-
8	Window	1 average	*m*
9	Door	1 average	*m*
10	Ceiling height	3	*m*
11	Floor/ Roof	25	m^2

IV. RESULTS AND DISCUSSIONS:

OPERATIVE, INDOOR MEAN AIR TEMPERATURE

The operative temperature is approximately the average of the air temperature and the mean radiant temperature. The comparative results of zone operative temperature throughout twelve months are given below fig 5. (window in West)

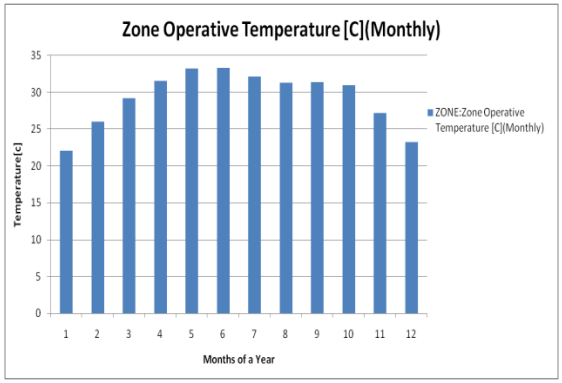

Fig.5 comparative results of operative temperature

An average size of window is located in West direction of Building to calculate operative temperature for achieving thermal comfort. simulated results for month of June are shown in fig 6

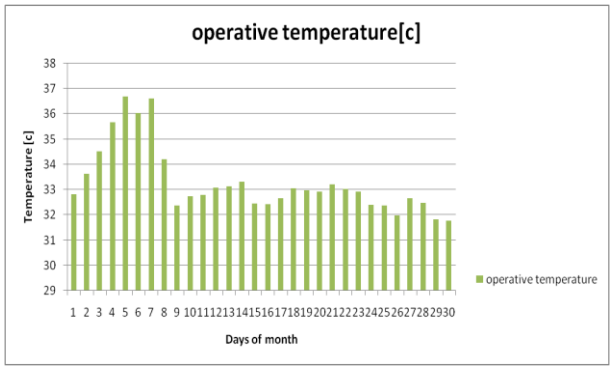

Fig.6 zone operative temperature facing west direction

An average size of window is located in East direction of Building to calculate operative temperature for achieving thermal comfort. simulated results for month of June are shown in fig.7

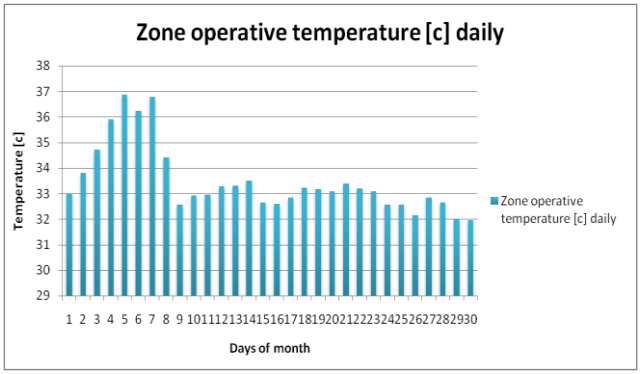

Fig.7: zone operative temperature facing East direction

An average size of window is located in North direction of Building to calculate operative temperature for achieving thermal comfort. simulated results for month of June are shown in fig.8

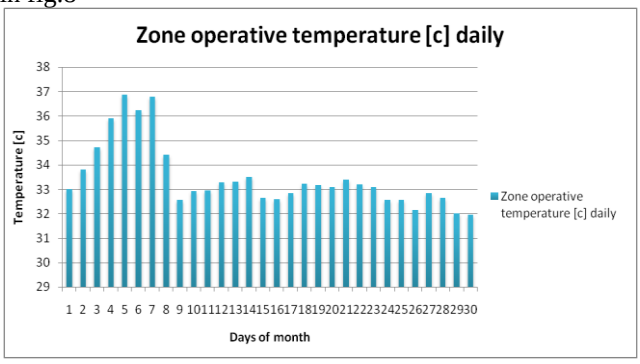

Fig 8: zone operative temperature facing North direction

An average size of window is located in South direction of Building to calculate operative temperature for achieving thermal comfort. simulated results for month of June are shown in fig 9

Fig 9: zone operative temperature facing South direction

From above fig 5,6,7 and 8 the thermal comfort and thermal discomfort hours are calculated by comparing ASHRAE general thermal comfort temperature 24-26^{0}C. The average of thermal comfort hours is calculated throughout twelve months during 8:00 to 18:00 as shown in fig 9

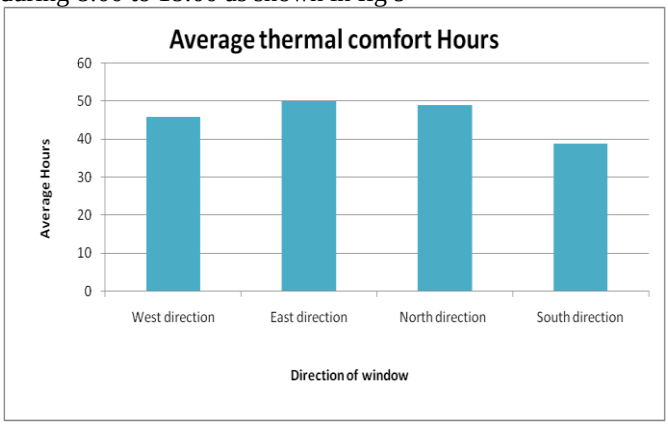

Fig.9 Calculated average thermal comfort hours

Fig:7 shows the comparative thermal comfort hours from simulation. The month of June has 14 comfortable hours and 316 discomfort hours from west direction during 8:00 to 18:00. The month of June has 13 comfortable hours and 317 discomfort hours from east direction during 8:00 to 18:00. The month of June has 14 comfortable hours and 316 discomfort hours from north direction during 8:00 to 18:00. The month of June has 2 comfortable hours and 339 discomfort hours from south direction during 8:00 to 18:00.

So it also show that the direction West and North has highest thermal comfort hours

The size of window is reduced, and the size of window 1m x 1m is entered in Energy Plus Building Simulation Software to calculate thermal comfort operative temperature. The results are simulated for all four direction of building. Simulated results are again compared to ASHRAE general thermal comfort temperature 24-26^{0}C, for month of June during 8:00 to 18:00. Thermal comfort hours and thermal discomfort hours are calculated for month of June during 8:00 to 18:00 as shown in Table:III

Month June	West	East	North	South
Thermal comfort hours compared to 24-26^{0}C	41	15	39	35
Thermal discomfort Hours	289	315	291	295

TABLE.III Thermal comfort hours for June month

After changing size of window the operative temperature is calculated from simulation results for month of June during 8:00 to 18:00 as shown in Table.III

The results are compared to ASHRAE general thermal comfort temperature 24-26^{0}C. The west direction results 41 thermal comfort hours, the East direction results 15 thermal comfort hours, the North direction results 39 thermal comfort hours and the south direction results 35 thermal comfort hours. So the direction of West and North has highest thermal comfort hours in month of June during 8:00 to 18:00.

Different size of window is applied to all four direction of building. When size of window is reduced the number of thermal comfort hours is increased in month of June during 8:00 to 18:00.

The difference of thermal comfort hours after applying different size of window is shown in fig: 10

Fig :10 shows the difference of thermal comfort hours using different size of window in a room. The direction of west has highest thermal comfort hours in month of June during 8:00 to 18:00

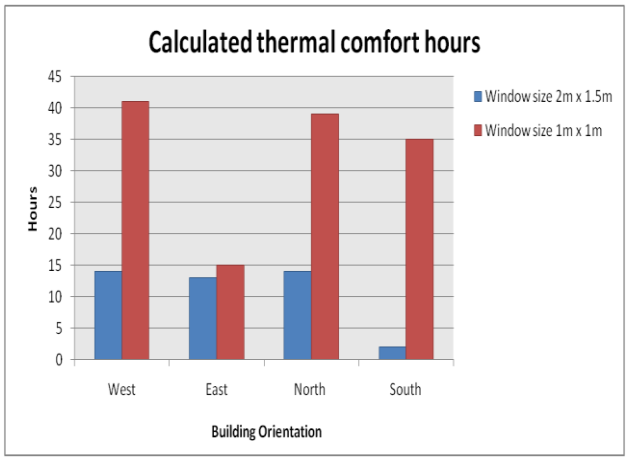

Fig.10Difference of Thermal comfort Hours

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V. CONCLUSION

Natural ventilation promotes healthier lifestyle. Natural ventilation results energy saving and achieves thermal comfort in a building. An office room 5 m x 5 m is designed to calculate operative temperature, a window 2 m x 1.5 m is introduced to all direction i-e West, East, North and South of building to achieve set temperature of 24^0 C – 26^0 C as according to ASHRAE general thermal comfort standard. This paper presents the simulation in the Energy Plus building simulation software. Through the simulation results, it is obtained that the hottest month is June. Through simulation it is obtained that direction of South has 41 thermal comfort hours compared to ASHRAE general thermal comfort standard. So the direction of West is best to place window in an office room in Hyderabad Pakistan.

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