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Assessment of Window Types in Natural Ventilation of Hotels in Taraba State

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Abstract

Natural ventilation provides the needed amount of good air quality through a natural process of allowing air in and out of buildings through the windows in order to achieve thermal comfort. There has been poor ventilation problem in hotels due to choice of windows which causes sick building syndrome. This research is aimed at specifying window types for effective ventilation in hotels. This is to be achieved through ascertaining of the window types used in hotels, ascertaining the window sizes used in hotels and to analyse the various window types in order to specify the effective types for hotels. In carrying out the objectives, two hotels were selected from each of the three senatorial zones in Taraba State where primary data were collected from a total of six selected hotels through direct observation. Secondary data in relation to natural ventilation and window types were gotten through review of literature. The data collected were analysed, using descriptive statistics. Findings and deduction were made. The concluding part of this research highlights the need and importance of using window types that provide the maximum ventilation in hotel rooms and other spaces. Recommendations were made for windows with high ventilation percentage to be used in hotels for effective ventilation.

Keywords: *Hotel, Natural Ventilation, Sick building syndrome, thermal comfort, window*

1. Introduction

An average person spends about 90% of his time indoors, as stated by Tine (2006), it is thus important to maintain focus on a good and healthy indoor environment by increasingly using sustainable methods such as the use of natural ventilation which is often discussed when buildings are being built. Natural ventilation has experienced a strongly growing interest, or even a renaissance. Relying on wind and thermal buoyancy as the driving forces for natural ventilation is surely not a new phenomenon or invention. Its utilization for the purpose of ventilation has for several millennia provided the desired thermal comfort and air quality for both man and animals (Tommy, 2003).

Natural ventilation provides the needed amount of quality air through a natural process of allowing air in and out of buildings through windows or other openings, thereby preventing indoor contamination and creating thermal comfort for occupants. Therefore, this research highlights those window types that are effective in allowing natural air into hotel buildings. This research is borne out of the fact that the wrong choice of windows causes poor ventilation in hotel buildings and in order to solve the poor ventilation problem, window types used in the hotels are going to be assessed. Window sizes used in the hotels are also going to be analyzed and the various common window types will be analyzed in order to specify effective types for hotel. Windows play an important role in ventilation of buildings. Its position and type matters allot on the amount of air that comes into the building. In order to get a good air exchange, windows will have to be opened for five to ten minutes in every three hours, (Passive House Resources, 2014). The amount of air that comes in will depend on the openings, verticality and its area, and this is where how the windows open comes to play.

Cai Feng & Wai (2010) found out that ventilation performs better with a bigger inlet than with a bigger outlet. It is effective when the inlet is bigger so as to allow enough air into the room. The outlet can be smaller and on the leeward side to let out stale air. Designers tend to understand and provide adequate opening sizes than the types of windows to be used in the openings. This is why there could be big enough opening, but when the wrong window type is used, it impedes the flow of air and poor ventilation is experienced.

1.1 Designing of Windows to Maximize Natural Ventilation

Hazim, (2010) stated that windows should be designed to achieve natural ventilation. But an important issue is whether the windows are single-sided or cross-ventilated to the interior spaces. According to the Sustainability and the Environment (2010), windows that are horizontally pivoted have high ventilation capacity. It further states that single-sided ventilation windows should be placed high in order to exhaust warm air at ceiling level, and the air that is entering at high level openings is directed to the ceiling which makes night time cooling effective. Windows that are pivoted at the centre have less ventilation capacity, but they can act as wind scoops when they are used in a wind direction parallel to the building face. (Hall, 2011).

Casement windows have the same advantages of the vertical pivot windows, but have the likelihood of being burst by wind. If casement windows must be used to channel wind, they should be opened in the wind direction when they are used as inlets and they should be opened away from the direction of wind when they are used as outlets. (Dutton, 2010).

Kevin, (2006) stated that fins or overhangs can be incorporated, if not part of the design, to create high and low areas of wind pressure and this will channel incoming air. Bay windows can be incorporated for instance, to create localized pressure difference and place windows on the opposite faces of the protuberance of the bay as inlets and outlets. There is always a positive or high pressure caused by wind on the windward side of the building and a negative or low pressure on the leeward side. Fresh air enters the building through the windward side where the windows should be located in order to maximise air flow, and warm air exits the building from the windows located on the leeward side. Windows no matter the efficiency in design, if they are not located in consideration to the wind direction, they are not going to maximize natural ventilation. (Adedayo, Ayuba, Oyetola & Audu, 2013).

1.2 Behavior of Operable Sashes

Andy, (2011) discussed in his research that the sashes of some window types that are operable are not always affected by wind direction. Windows like sliding windows, where the sash stays directly behind the fixed one when completely opened, double hung windows and louvre windows are in this category. While Cei Feng & Wai (2010) explained that the sashes of other window types might increase or reduce the flow of air depending on the flow of air. The sashes of casement windows can redirect the wind to the window opening or reduce the amount of air flowing to the window by shielding the window opening. Wind blowing indirectly against awning windows can channel air into the window on the windward side of the sash. This can happen simultaneously with taking air out on the leeward side of the sash. Air flow can be impeded significantly by the operable sashes of awning windows with winders. (Breezeway Technical Bulletin, 2012).

2. Study Area

Taraba state is one of the developing states in Nigeria, and the growth in the number of hotels in the state is an area in which development can be seen. These hotels offer accommodation to travelers in transit to the north east and to the south south, as a nature's gift state, it also welcomes tourists who seek for shelter in these hotels. Taraba State as a study area is one of the North Eastern States in Nigeria, created in 1991 from the old Gongola State. The state has sixteen Local Government areas with Jalingo as the headquarter. The state is bounded on north by Adamawa, Bauchi and Gombe States. In the west by Plateau and Benue States and in the east by Cameroon

3. Methodology

The data for this research were gotten from primary and secondary sources. The primary source of data was collected through direct observation. Taraba State has sixteen Local Government Areas, and these Local Government areas are divided into three senatorial zones (Taraba North, Central and South). Two hotels were selected at random from each of the senatorial zones (Sanaf Suite and Yukuben Hotels from Taraba North, Travellers Lodge and Seven Sisters Hotel from Taraba Central and Elim Top Suites and Rohi Grand Suites from Taraba South) and observations were carried out with the aid of an observation schedule in a total if six hotels in the state. The schedule looks critically at the types and sizes of windows in the hotels. While secondary data were collected from the review of related literature.

4. Discussion Of Results

4.1 Ascertaining the window types used in hotels

The table below shows the types and number of windows used in the hotels as extracted from the observation schedules.

Table 1: Window types used in hotels

Name of Hotels	*Casement windows*	*Sliding Windows*	*Louvre Windows*	*Projected windows*	Total
Sanaf Suite	*89*	*8*	*0*	*47*	144
Yukuben Hotel	*0*	*74*	*0*	*8*	82
Travellers Lodge	*0*	*46*	*5*	*0*	46
Seven Sisters	*0*	*16*	*27*	*0*	43
Elim Top Suites	*0*	*109*	*0*	*8*	117
Rohi Grand Suites	*0*	*39*	*0*	*3*	42
Total	*89*	*292*	*27*	*66* *66*	474

Source: *Field Survey 2014*

The table above shows that 89 casement windows were used, and were used only in Sanaf Suites. 292 of sliding windows were used and it is the most used window type. This window type does not give a good amount of ventilation, but it was used because it is the window type in fashion, it is easy to assemble and considerably cheap. 27 Louvre windows were used and it is the least used window type even when it is a good window type for ventilation. This is because it is an outdated window type and good quality can be hardly gotten. 66 projected windows were used in the hotels. Projected window gives some good amount of ventilation but is not cost effective when compared with sliding window, hence it is not often specified for usage. The table above is also presented in a summary chart below, showing sliding window in red bars as the most used type of window in the hotels.

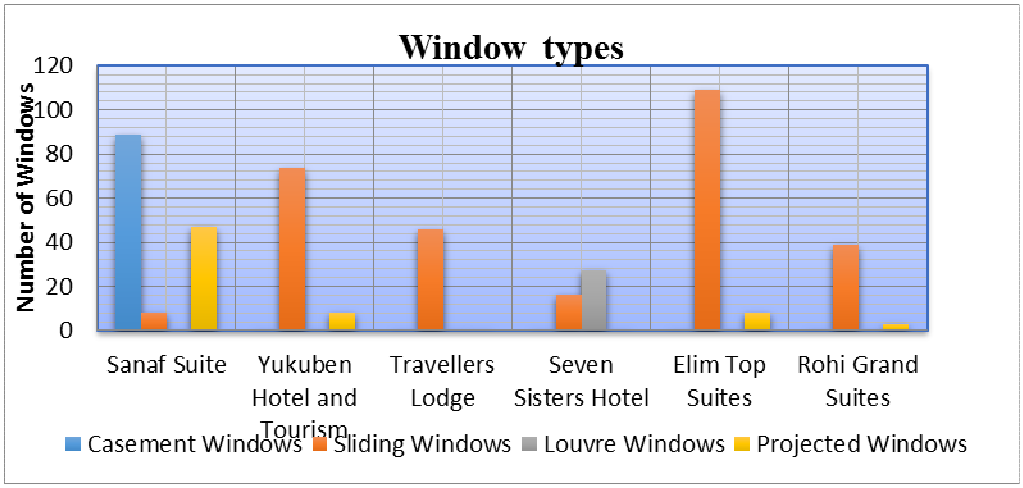

Figure 1: Distribution of Window types used in the hotels Source: (*Field Survey 2014)*

Plate1: Sliding windows in Yukuben Hotels
Source: *Field Survey 2014*

Plate 2: Sliding windows in Rohi Grand Suite
Source: *Field Survey 2014*

Plate 3: Sliding windows in Seven Sisters Hotel
Source: Field Survey 2014

Plate 4: Louvre windows in Elim Top Suite
Source: Field Survey 2014

Plate 1 to 4 above show the various types of windows used in the hotels. Plate 1 shows that projected windows were used in the reception and restaurant building on the left side in the plate and sliding windows were used in the main hotel building in Rohi Grand Suites. The projected windows were used in small number and in big sizes compared to the sliding windows in the main hotel building which are more but in smaller sizes. Plate 2 shows some of the sliding windows used in Yukuben Hotel and Tourism on one of the blocks. Basically, all the windows in the hotel are sliding windows the Plate 3 shows also the sliding windows used in Elim Top Suites and in different sizes, while plate 4 is the only one that shows the use of louvre window in a bedroom in Seven Sisters hotel.

4.2 Ascertaining the window sizes used in the hotels

The table below shows the different window sizes used in the hotels as extracted from the observation schedule.

Table 2: Window Sizes used in the hotels

Name of Hotels	*2.7x1.2m*	*2.4x1.2m*	*1.8x2.4m*	*1.8x1.2m*	*1.5x1.2m*	*1.2x1.2m*	*1.2x0.6m*	*0.9x1.2m*	*0.6x0.6m*	Total
Sanaf Suite	*3*	*0*	*1*	*1*	*0*	*94*	*4*	*0*	*41*	144
Yukuben Hotel	*0*	*1*	*2*	*0*	*0*	*46*	*0*	*0*	*33*	82
Travellers Lodge	*0*	*0*	*0*	*0*	*0*	*30*	*0*	*0*	*16*	46
Seven Sisters	*0*	*0*	*0*	*0*	*0*	*21*	*0*	*0*	*22*	43
Elim Top Suites	*0*	*0*	*8*	*4*	*0*	*51*	*0*	*16*	*38*	117
Rohi Grand Suites	*1*	*0*	*0*	*2*	*12*	*15*	*0*	*1*	*11*	42
Total	*4*	*1*	*11*	*6*	*12*	*258*	*4*	*17*	*161*	474

Source: Field Survey 2014

From table 2 above, it shows that the most used window size in the hotels is 1.2x1.2m with 258 in number. This window size was used mostly in the bedrooms because it is a standard bedroom window size and it is cheaper than bigger sizes. Dependence on mechanical ventilation does not consider bigger window sizes, most especially for bedrooms, but light. There are 161 of 0.6x0.6m size. It is a standard size used in the toilets, hence it was used. 4 of 1.2x0.6m were used as high level in a passage in Sanaf Suites; this size is big enough to let out stale air from the passage but are not always open. 17 of 0.9x1.2m size were used. This size was used in some bedrooms where there are no enough wall space to accommodate bigger size, thereby causing poor ventilation, 11 of 1.8x2.4 were used in the reception area where there is need for more light and air but are not adequate. 4 of 2.7x1.2 were used where there is a bigger space like the restaurant, and there is the need for much air and light. The summary of the table above can be seen in the chart below with 1.2x1.2m windows size in red colour dominating the chart as the most used window size.

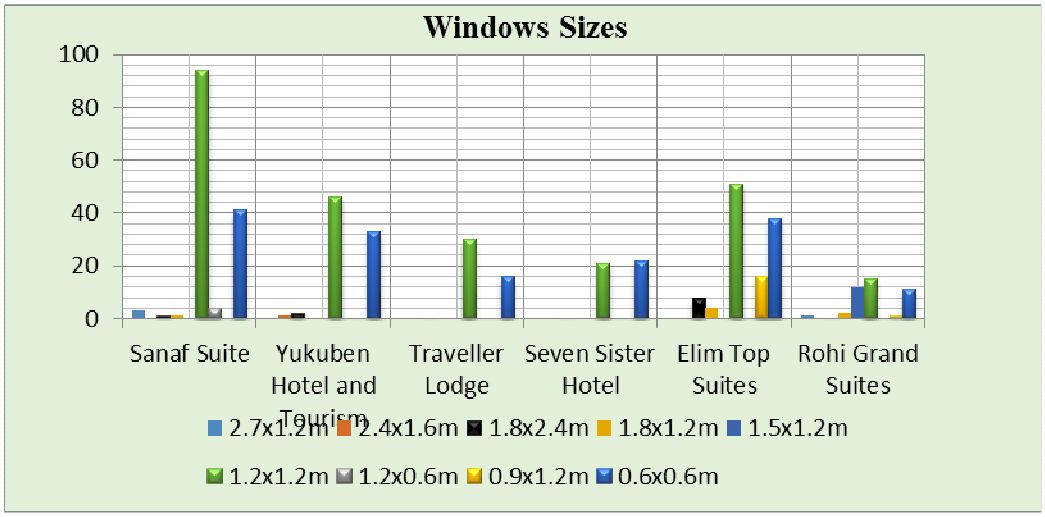

Figure2: Window Sizes used in hotels *Source: Field Survey 2014*

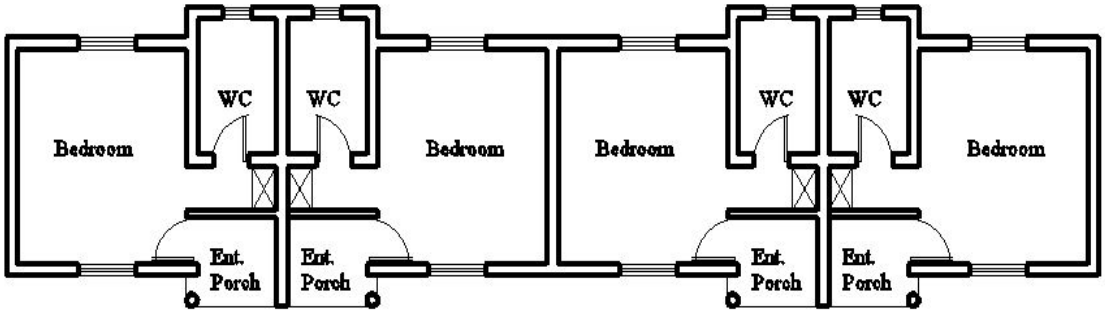

Figure 3: 1.2x1.2m and 0.6x0.6m sliding windows in a hotel block in Sanaf Suites
Source: Field Survey 2014

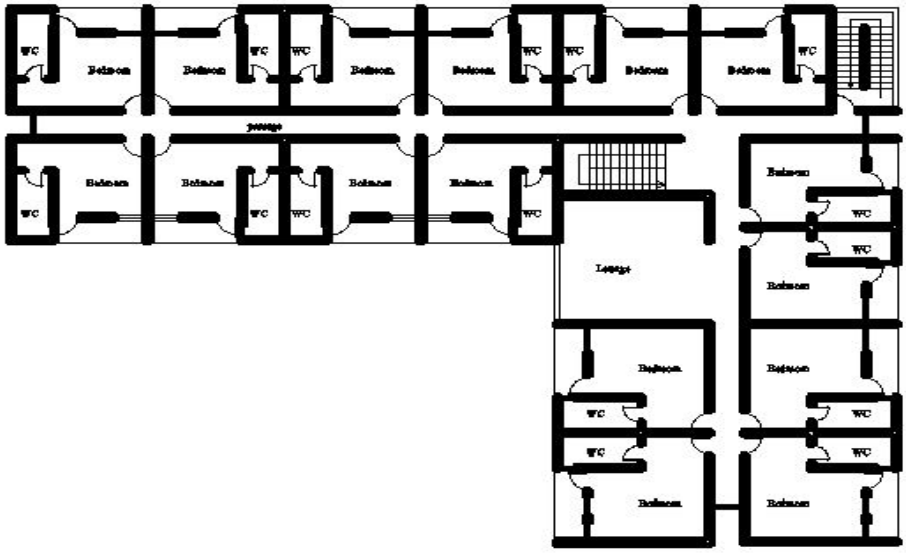

Figure 4: Different sizes of sliding windows in Elim Top Suites *Source: Field Survey 2014*

Figure 3 above is a sketch of one of the blocks of Sanaf Suites. The window size used in the bedrooms is 1.2x1.2metre size of casement windows and the toilet window size is 0.6x0.6metre size of casement windows, and there are eight of such blocks in the hotel. Figure 4 is a sketch of the first and second floor of Elim Top Suites. The windows sizes used in this typical floor plan are 1.2x1.2metre and 0.9x1.2metre in the bedrooms, 0.6x0.6metre in the toilets and 1.8x2.4metre in the passages. 1.2x1.2metre is a standard bedroom window, but 0.9x1.2metre is not a size that will provide efficient ventilation, but it was used due to lack of wall space to accommodate bigger window size.

4.3 Analyses of Various Types of Windows

The types of windows analysed is based on the common window types used in the study. Which are casement windows, sliding windows, projected windows, fixed light, and louvre window.

4.3.1 Casement Window

According to Breezeway Technical Bulletin (2012), the sashes of casement windows can only minimally reduce air flow when the window is opened with the sash in a perpendicular position. Casement windows are hung on the vertical sides of the frames, that is, if the window has double leaves. It can have single leaf and be hung on one side. The leaves can open 90-180 degrees, allowing maximum air flow in the room.

4.3.2 Sliding Window

Sliding windows usually have panels or sashes that slide along tracks on the window sill. The sash that slides, sits directly behind the fixed pane when the window is completely opened. The amount of air that is offered by this type of window is half of the entire window size. Very big window sizes will be needed if sliding window is the specification. This is to achieve maximum air flow when the panel slides.

4.3.3 Projected Window

This type of window is hung on the top and can open at different angles up to 90 degrees, depending on the amount of air that is to be allowed in. In any case it allows for maximum air inflow when opened.

4.3.4 Fixed light window

These types of windows are not meant for ventilation because they are not made up of operable partitions (panels) or sashes. They are permanently fixed just to allow light into a space in the building.

4.3.5 Louvre Window

This type of window has horizontal blades that open perpendicular to the window when completely opened. The blades to an extent impede the air flow, but a great amount of air still gets into the room. Table3 below shows the various types of windows with their ventilation percentages. These are common windows used in the study area, as ascertained earlier. It shows that casement window can give 80% ventilation as the most effective in the table. Louvre window is a type of window that for a long time now, its usage has seriously declined, but can offer 75% ventilation. Projected window can offer 50-80% ventilation depending on the winder or the opening angle. The least percentage is sliding window with 40% ventilation, and it is the most used type. The summary of the table can also be seen in figure3 chart below.

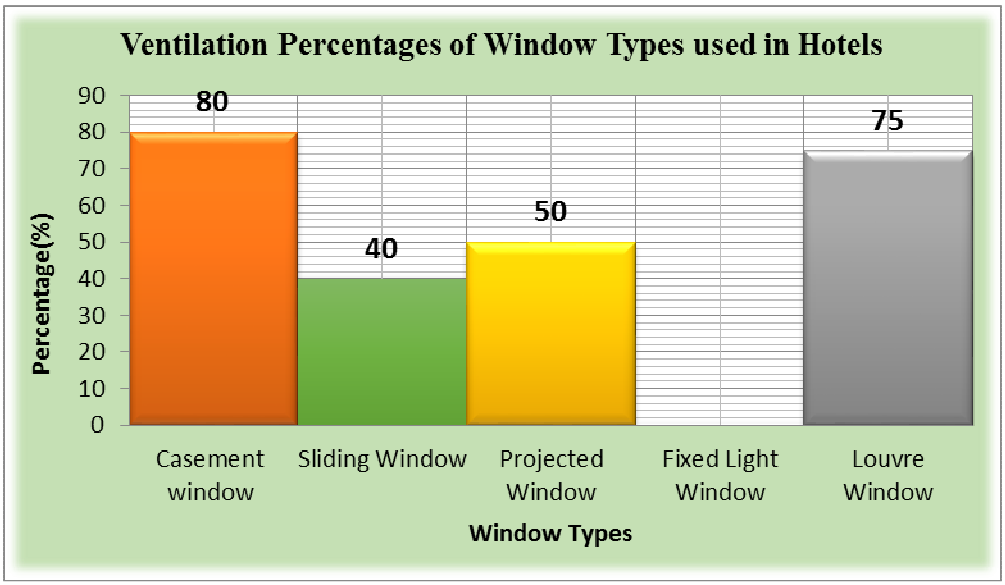

Figure 5: Chart of the ventilation Percentage of various window types used in hotels,
Source: Adopted from (Breezeway Technical Bulletin, 2012)

5. Conclusion and Recommendation

Window types have great impact in determining the amount of ventilation that windows will provide in tackling poor ventilation. The most effective window types should be used in the ventilation of hotels. Sliding windows were mostly used because it is considerably cheaper and the prevailing type that is in use, but not because it is good for ventilation. The use of air conditioners makes hotels to use sliding windows, after all they are not going to be opened. Using window types that provides the least percentage of ventilation in a standard window sizes

that should have provided enough ventilation is a serious challenge. This research shows the need to understand the types and sizes of windows to be used in hotel designs so as to achieve a breakthrough in hotel ventilation. Therefore, it can be recommended that;

- Sliding windows should be replaced with casement, louvre windows or projected window.
- If sliding window most be used, its size should be big enough for the slid sash or sashes to offer maximum ventilation.
- Windows, no matter the size or type should be located to take advantage of the prevailing winds.
- During the design stage, windows such as casement, louvre and projected windows should be specified for maximum and effective ventilation.

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