

# The Effect of The Gable Orientation on The Artificial Ventilation Consumption at Residence Houses in Medan

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DOI: [10.21276/sjce.2019.3.2.1](https://doi.org/10.21276/sjce.2019.3.2.1)

## Abstract

The aims of the research are to investigate the effect of gable orientation on the artificial ventilation used, and the intensity of artificial ventilation used which is effected by orientation gable. To achieve the aims of the research, mix research method was used in which both qualitative and quantitative research method was used to obtain the more valid, comprehensice and objective findings of the research. The techniques of collecting the data were literature study, observation in which and the instruments of the research used were the data from literature study, questionnaire with likert scale. After the data found, this research showed that the number of orientation of the roof will affect the ability of roof itself to withstand the heat in order not to increase the consumption of artificial artificial excessively based on both the orientation of both ideal and unideal direction at houses laid in Jasari Park Residence Medan. Then, based on a questionnaire using Likert scale, the roof orientation in residential areas shows that North-South and East-West has completely greater intensity in using the artificial ventilation than the roof orientation towards Southeast-Northwest and Southwest- Northeast. This condition occurred because this orientation of the roof surface of the building and the sides of the wall are not only higher, and it absolutely reinforce the roofs that are facing in front of the orientation of the sun.

**Keywords:** Gable orientation, gable, residence, artificial ventilation.

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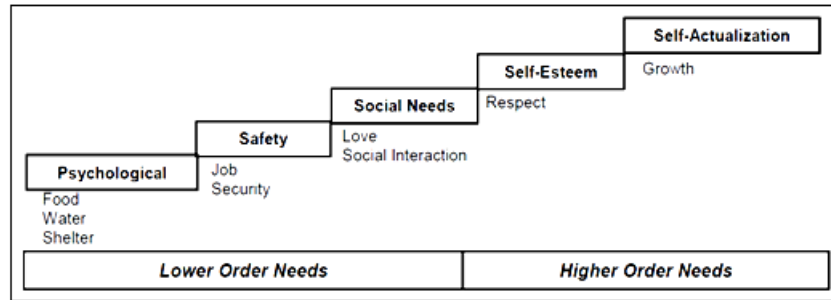
## INTRODUCTION

The consumption of electricity in the houses in the tropics definitely reaches up to 40% of the total load needed to cool down the rooms from the accumulation of the indoor heat in which this kind of situation frequently occurs in Medan, Indonesia. Based on the previous reseach, the data showed that 80% of the heat load from houses is not only affected by the design of the walls and roof of a house but it is also affected by other heat sources [1]. It clearly shows that the issue of wall and roof design choices especially artificial ventilation that use building elements can have an impact on the level of the consumption of electrical energy. The excessive use of electricity occurs due to the heat of the room sourced from the roof against the orientation of the sun, so that more electricity is needed to maximize the comfortabile space. Yet, the waste of electricity should be prevented by considering wall and roof design choices [2]. Based on the phenomena above, this research aims to investigate the orientation

of the suitable gable used in houses that it absolutely gives an impact on The consumption of electricity in which the case studies taken is in Jasari Park Residence in Medan city located in Air Bersih Street, Medan Denai District Indonesia where at this location there are houses with an average building area with 54 m<sup>2</sup> whose the roofs oriented to North and South, East and West, Southeast and Northwest and Southwest and Northeast with the same types of houses.

## LITERATURE REVIEW

Particularly, a house is the essential necessary for human being. Yet, the role of houses may depend on the level of fulfillment of human needs themselves. According to Maslow [3] there are 5 levels of the fulfillment human needs visualized through pyramid diagram called as Maslow pyramid that is related to the level of human needs for a house as shown as Figure-1.



**Fig-1: The Abraham Maslow's Hierarchy Needs (Kreitner, 2003) [19]**

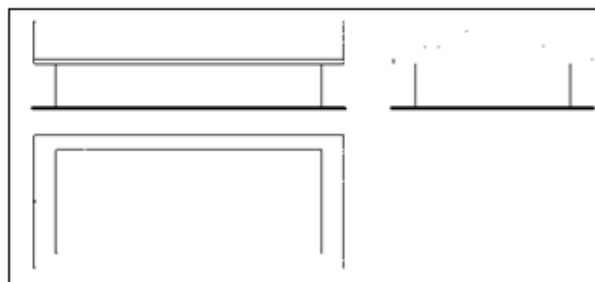
Based on the diagram above, it clearly shows that there are 5 levels of the fulfillment human needs, namely; psychological, safety, social needs, self-esteem, and self-actualization. In other words, the human being can achieve the highest order need which is self-actualization if the lower needs such as; psychological, safety, and social needs in which anyone possessing the house as an expression, privacy, beauty, and comfort are completely met. After all the lower order needs are achieved, the higher order needs automatically are fulfilled.

Relating to owning the houses, the urgency of roof selection becomes more essential since the quality of roof should be considering the local climate, the available costs and and the suitable materials that the building was established [4]. There are three underlying factors influencing the shape of roof, namely; rain, heat and wind. It is highly expected that the shape of the

roof must be able to resist the heavy rain, the bright sun and the strong wind, in which the most influencing factor giving impact to the shape of roof is the sun [5].

Besides, the orientation of the roof will also gives a great impact on both the comfort and the failure of a building as the role of the roof is to resist excessive heat radiation. Therefore, the impact of the roof orientation on a residential house straightly relates with the the comfort of a room in a residential house [2].

In order to meet the necessary of the choice of roof, according to Kusjuliadi [6] who stated the building science that the gable can be categorized to be the simplest roof that can be used for houses in tropics. It is because of There are only two hypotenuse and the other sides are only a conical triangular wall as seen in Figure-2.



**Fig-2: Gable Roof**

Theoretically, if the surface that is opposite to the fall of direct radiation is minimized, the quantity of the heat transfer process occurred decreases as well [4]. It is known that, the sunlight certainly causes the heat matters so that the protection that can be done to anticipate these problems can be used by the principles of both light imaging and light filtering [7].

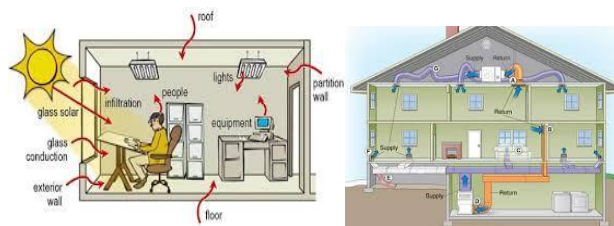
The orientation referred to in this research is the orientation related with the position of the roof of a simple residential house that the orientation of the roof will definitely affects on the amount of sunlight

radiation entering the building. It means that both width and orientation of the roof will give a great impact on the power of the building to withstand the heat from the sunlight [8]. In general, the orientation of the roof for residential houses does not only refer to one direction but it also refers to the various directions. In fact, the houses laid in the residential Jasari Park Residence shows that the orientation of roof tends to face both front and back direction. While, roof orientation as an element of a residential house is expected to be must be in accordance with other factors in order to get as much benefits as possible either from heating or from air

conditioner. Hence, that houses does not really need a lot of artificial ventilation that causes an excessive energy used [9]. Moreover, the orientation of the roof sets the amount of solar radiation that falls on the surface with different directions and different times. It has been recognized that solar radiation with air temperature produces heat either on object or on surface [10].

It is generally known that, If the room is being hot and stuffy, people who carry out activities in that place will certainly be feeling very disturbed, uncomfortable, and unable to do their activities properly. It shows that the comfortable room regarding air must be fulfilled completely which includes air temperature, air humidity, air movement and air cleanliness levels [11]. Yet, in this current situation, the

natural ventilation never be enough for the air circulation of single house. Thus, If natural ventilation does not meet the house standards, the other alternative that can be used is artificial ventilation. There are several reasons of using artificial ventilation including temperature, pollution, space design and poor circulation [12]. In order to obtain a proper system and the right cooling capacity, the amount of heat load that occurs is determined by the heat transfer of solar radiation [13]. Recently, most houses in tropic need artificial air conditioning such as air conditioners, fans and other types of artificial air in order to make the room being comfortable. However, it definitely costs electricity charge to increase for procurement and operation that make the electricity needed for a single house will increase as well as seen in Figure-3 [14].



**Fig-3: The Illustration of the needs of Artificial Ventilation at Houses in Medan (Source; the analysis of researcher)**

The Figure-3 above shows that the use artificial of air ventilation is frequently applied in a single house to anticipate of lack of air that surely consume much energy. Therefore, it takes effort to have a comfortable room with the exact temperature by anticipating the heat entering the building to minimize energy use for a single house [15].

## RESEARCH METHODOLOGY

In order to achieve the aims of the research, mix method research is used since mix research approaches between quantitative research and qualitative research method in order to obtain more comprehensive, valid and objective data [16]. For qualitative research design, due to the flexibility of qualitative research design in which everything changes occurred based on the existing condition, both standard patterns and systematic stages undertaken as the benchmark are not being used [17].

The technique of data collection consist of two stages, namely; literature study, and observation, and questionnaire. Firstly, literature study is carried out to collect the data of gable, gable roofing and some references needed in planning data obtained, such as; books, magazines, bulletins, and articles. Secondly, observation to the location of the research is undertaken [18]. This research is conducted from 3 May 2016 to 15 July 2016. The subjects of the research chosen are those who are homeowners with the characteristics determined by the researchers, namely: 1) the houses

have a roof orientation towards North and South, East and West, Southeast and Northwest and Southwest and Northeast. 2) the houses have at least 2 types of artificial airing in each house. 3) the houses have the same floor plan or spatial layout for each house which is the instrument of the research. 4) the houses have the same form of gable for each residence which is the subject of research. Thirdly, after all characteristics was met, then, the researcher approaches and consults with each homeowner about the procedures, objectives of the research conducted how technically the research was conducted, and the subjects of the research finally agree to fill in the questionnaire sheet provided

## DISCUSSION

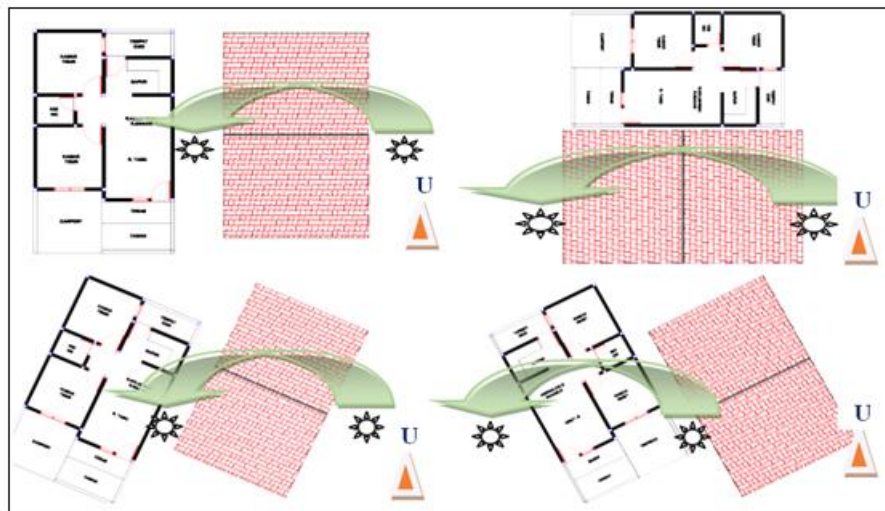
Based on the data found, the background of subjects of the research are categorized into some aspects, namely: gender, age, occupation, education background, family members, and house functions. First, The data related to gender shows that 67% of men, 33% of women owned the housed. Second, the data of the age of subjects of the research shows that the subject of the research with 0-29 years is 33%, the subject of the research with 30-39 years is 50%, the subject of the research with 40-49 years is only 17%. Third, occupation of the homeowners are classified into; 17% civil sercvants, 33% private employees, 17% traders / entrepreneurs, and 33%, retirees. Fourth, the background of education shows that 16% high school, 17% diiploma, 50% , Master degree is 17%. Fifth, the homeowners with 2 family members are 33%, the

homeowners with 3 family members are 17%, the homeowners with 4 family members are 17%. Sixth, there is 50% of houses functioned as offices, and there is 50% of houses functioned as houses.

Moreover, based on the observations followed by a survey, there 35 houses laid in Jasari Park Residence housing Medan city shows that the condition of the houses is reasonably proper, and the artificial ventilation in the houses frequently used. The orientation of the gable on the house and measurement of the spaces so that it can be ascertained to the same building area, and spatial layout for each house is identified to see the effect of the intensity on the use of artificial ventilation based on the similar building area.

Thus, that the house selected according to the terms and criteria is a house with roof orientation conditions facing North and South, East and West, Southeast and Northwest and Southwest and Northeast. Each house chosen is a house that uses artificial ventilation.

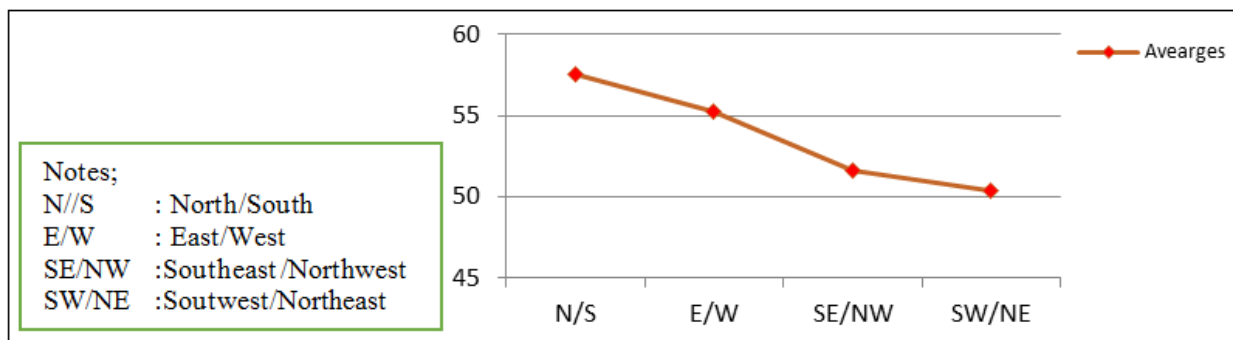
Furthermore, the observation of the research some houses with the roof orientation facing to North and South needs the artificial ventilation such as air conditioners and fans. Then, the intensity of the use of artificial ventilation is totally different in In each house in each house in which the artificial ventilation used depends on their activities at homes. Detailly, the directions of roof is visually shown in Figure-4.



**Fig-4: Roof Orientation Analysis (analysis of researcher)**

To answer the second problem formulation, a questionnaire was distributed to each homeowner in a in the Jasari Park Residence housing located at Air Bersih street Medan. Based on the result, From the results of the average values on the artificial intensity

table, it shows that there are 4 points of compass can be drawn, then the North and South points of compass have the highest value on the consumption of artificial air in simple residential houses as seen in Figure-5.



**Fig- 5: The Intensity of The Use of Artificial Ventilatoin in Jasari Park Residence Medan, Indonesia**

The figure-5 above clearly shows that, it could occur because the direction of the building's roof orientation has an influence on the consumption of artificial artificial excess. Surely, it is related to the side of the sheath of the building facing stratightl to the

direction of sunlight when the intensity of sunlight is high and the time when sunlight hits the surface of the field. The stronger the intensity of the sun and the longer the duration of sunlight hits the roof of the building, the greater external heat obtained by the roof.

Furthermore, The orientation of the roof of the building towards North and South, where at that orientation the surface of the roof of the building faces directly to the direction of sunlight leads to the more exposure received to solar radiation with the high intensity, the more solar radiation energy that hit the roof of the building, then, the consumption of artificial ventilation will also increase and the intensity of usage increases as well.

## CONCLUSION

Based on the analysis, the condition of the gable roof orientation in residential areas located in Jasari Park Residence Medan are very varied in which it leads to the gap for buildings to withstand the heat from solar radiation as a result of the sun's path either it is being ideal or not. This condition absolutely related to the number of orientation of the roof will affect the ability of roof itself to withstand the heat in order not to increase the consumption of artificial artificial excessively based on both the orientation of both ideal and unideal direction at houses laid in Jasari Park Residence Medan. Then, based on a questionnaire using Likert scale, the roof orientation in residential areas shows that North-South and East-West has completely greater intensity in using the artificial ventilation than the roof orientation towards Southeast-Northwest and Southwest- Northeast. This condition occurred because this orientation of both the roof surface of the building and the sides of the wall are not only higher, and it absolutely reinforce the roofs that are facing in front of the orientation of the sun. In conclusion, the more solar radiation received with higher intensity, the more artificial ventilation at home used in Jasari Park Residence Medan.

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