"*Keongan*" Ventilation Roof on Local Houses in Semarang City Indonesia

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Abstract- Keongan is a kind of roof ventilation usually used in indonesian local houses. In a humid tropical climate, in general, the building is designed with natural ventilation system that maximizes the speed of wind in order to cooling the building structure or reach the achievement of physiological comfort. Some of the building design features in a tropical climate, such as the existence of wide openings, roofs with a slope angle, have a plafond, and maximizing the shades around the building. The density of buildings is one of the factors which affect the principle of micro-climatic conditions and determine the conditions of ventilation and air temperature. Heat symptoms in main cities affected by urban density rather than the size of the city itself, the more dense, the worse the condition of the building ventilation. Architecture of buildings, tried to adapt to the nature and tried to blend with nature. Norms, customs, climate, culture, beliefs and local materials will be given its own color in the development of vernacular architecture. The long journey through trial and error with the local genius, is capable to displaying it's identity. Several features of houses in Semarang Village include : symmetrical floorplans extends to the rear, circulation straight from front to rear, limasan roof or saddle roof, three openings (doors) on the facade, door consists of two doors, Ornaments eaves (lisplank) on the front facade, the Consul made of iron or wood with the formation of ornamentation, Ornaments on bouven above the door. The results of this study, the shape of gable roofs are part keongan utilized for the air stream that is useful to cool the hot air under the roof at once will lower the temperature in the house. Roof ventilation in Semarang houses mainly applied keongan and openings in the ceiling to circulate the hot air out of the building. Roof ventilation in the form of air cushion roof due to the formation of a high roof space. High roof shape with a roof vent to expel the hot air trapped on building roof. This adaptation is one of the advantages of traditional buildings. This can be important lessons in developing the design by applying the model of natural ventilation for the comfort of the building.
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Index Terms- Roof ventilation, local wisdom, local houses.

I. INTRODUCTION

Indonesia lies in the geographic conditions located at the equator, that resulted the climatic conditions in Indonesia are hot and very humid so it is known by the humid tropical climate. Humid tropical climate by Egan (2009) & Szokolay (2004), has the characteristic features such as high temperatures during the day and low temperatures at night, has a very high humidity level, having low air movement and low speed of wind, and a high intensity of sun exposure. The humid tropical climate conditions needs the level of planning that responds to climatic conditions and friendly to the environment that also make the people comfortable. The tendency of the problems encountered in the humid tropics is the same that the magnitude of heat in the building that influence the formation of air temperature in the room. Cities with high building density, are having impact on the poor socio-economic conditions and will potentially make the area into a slum. The need for open communal spaces in each row and a residential neighborhood. (Santoso, 2007). How to determine the level of density of the region and the environment quantitatively based on the number of occupants who occupy the building in hectares. The density of an area can also be calculated based on the number of buildings in hectares or calculating overall Basic Building Coefficient (KDB) in one hectare. Environmental Building solid in the category if the number of buildings around 80-100 buildings per hectare or more than 100 buildings in a single hectare. Basic Building Coefficient (KDB) about 50-70% for high density, or more than 70% of the environment is earmarked for residential buildings. Indicated that the density implicated in the squalor of the environment. The density of buildings is a one of the causes that will affect the climate conditions and the environmental impact on the movement of air flow for natural ventilation, the following also with an increase in ambient temperature.

Roof ventilation design that planned to support the concept of air jetting to above will be managed to create a good thermal comfort inside the building if all aspects of planning have been considered and taken into account. It is important to do because of the failure of the roof ventilation design will likely have the opposite effect, which adds to the discomfort in the room due to heat buildup in the field of space.

Szokolay (1987), describes a method for optimal passive cooling humid tropical climate is the effect of wind movement, namely physiological cooling not only depend on the wind speed but also the activity and clothing used by humans. In this passive cooling methods can expand your comfort zone is perceived by humans.

Research Sukawi (2009, 2010) Wooden houses from the Dutch stage in Purwodadi have Kedung teak ceiling elements made of planks. Installation of ceiling is not tight so that there is a gap that allows air into the room through the gap. This study knowing that porousitas ceiling wooden boards serve to expel warm air to the roof that will affect the indoor thermal conditions stated by the effective temperature (TE).

Purwanto (2006), form the roof of the building must have good air circulation. Roofs that do not have air circulation will conduct heat of air trapped in the roof to affect the condition of the heat in the room below. The use of modern roofing materials a very tight result in the absence of openings in the roof so that the roof can not "breathe" and the heat that occurs in the roof will affect the thermal conditions in the space under the roof. For the design of a good roof must have a good circulation system so that hot air is not trapped in a roof cavity.

Research on thermal comfort in rural areas that did in the area of East Java, found that the orientation of the house will be facing the village road that also serves as a communal space and social interaction. In traditional Javanese architecture there is no rule about the orientation and the direction toward the dwelling or residence. For that opportunity their orientation can be adjusted with the direction of circulation of the sun and the movement direction of the wind. This study indicates that the orientation does not have much effect on the thermal comfort in low-rise buildings. However, the removal of heat by the wind to the openings on the building will create efforts to cool buildings that have an impact on the level of heat in the building. (Samodra, 2005).

II. RESEARCH METHODOLOGY

Research methods used in this study is the observation method with a descriptive survey. The research object is a residential building which has a high density of residential homes in the hometown, in this case the research conducted in Pendrikan Village Semarang. Descriptive survey aimed to explore the phenomenon / symptom by observation. Observation method is a method that is done by direct observation, measurement and recording of symptoms or phenomenon. (Arikunto, 1998).

The method in this research is the observation, recording of measurement points inside and outside the home with tools such as a thermometer (to measure outdoor and indoor temperature), hygrometer (to measure humidity), hot wire anemometer (to measure air movement within both indoor and outdoor). Determination of measurement points in the house, carried out on the living room or family room and the space under the roof located at the back of the house. While the outdoor measurements carried out on the patio and the street in front of the residence. The collection of primary data collected in the field, will be in synchronize with secondary data such as temperature, humidity and wind movement from BMKG to see urban macro-climatic conditions and the environment.

III. RESULT AND DISCUSSION

One characteristic of dense residential village is downtown city. The village is a residential area of low-income people with poor physical condition. Village is a slum area with poor availability of public facilities or none at all, this region is often called the "slum" or "squater". Village is a traditional Indonesian environment, that marked the characteristic of life that exists in a close familial bond. Dirty Village which is a unique form of settlement can not be equated with a "slum" and "squater" or also equated with low-income settlements. Hometown is a form of settlement in urban areas unique to Indonesia with the characteristics, among others: the population still carry the nature and behavior of rural life are intertwined in family ties are strong, physical condition of the building and the environment is not good and not uniform, the density of buildings and high population, straitened means of basic services such as clean water, sewerage and storm water, garbage disposal and more. In the 1800s, the area along Imam Bonjol Street and Indraprasta street, a Dutch-owned land named Frederick, some called Van Hendrick and Prins Hendriklaan. Now, residential areas and offices in the region was better known by the name Pendrikan or Pindrikan. Due to limited land and space requirements, it is a spatial pattern tends town house in the village extends rearward. As a result, the spatial arrangement of rows backward from the terrace, living room, bedroom, family room or dining room and kitchen. The room service is placed at the rear. This backward elongated shape topped with a gable roof with mountains in the front and rear facade. Gunungan is part of the roof contained ornamentation in the form of openings, known as a roof vent on the lid of a snail.

Figure 1. Front Fasade House with “Keongan”

Figure 2. Front Fasade House without "Keongan"

This study begins by comparing two houses which the spatial form is nearly equal, start from spatial and material development as well as the walls and roof. The original wall materials are using plastered red brick walls. While the roof is still using clay tile and asbestos and zinc on the terrace .. The second differences between these houses, is on a roof vent located on 'gunungan' known as keongan roof. Mr. Sukadi's home is apply a roof vent while the house of Mr. Ari does not have a roof vent.

Further research is done by searching for the ideal shape of a roof vent. One of many ways, is to look at some models of roof vents form in residences found in the field. From the survey, it was found that several models of roof vents form the shape of the house and a sketch that does not change drastically with a sketch of elongated backward.

Average house that has a roof vent has a greater air movement than the house without a roof vent. Difference in air movement in the room ventilated house with a roof of a house without a roof vent ranging from 0.01 m / s to most 0.39 m / s. The biggest difference at 02:00 PM to 04:00 PM in the afternoon and evening and the lowest difference at 5:00 to 6:00 o'clock in the morning. The average difference between the indoor air movement ventilated house with a roof that is not ventilated is 0.05 m / sec

Wind or air movement that occurred under the roof is also different between the 2 occupancy compared. The following graph the difference between the movement of air environment with air movement under the roof of the house of village equipped with openings keongan roof with houses that do not have openings keongan roof. To strengthen the research results in the data from the results of field measurements performed well simulation studies with ANSYS software. The results of these simulations will strengthen the research results in the field.

Mr. Ari's House

Simulations performed by ANSYS with the wind speed of 1 m / s

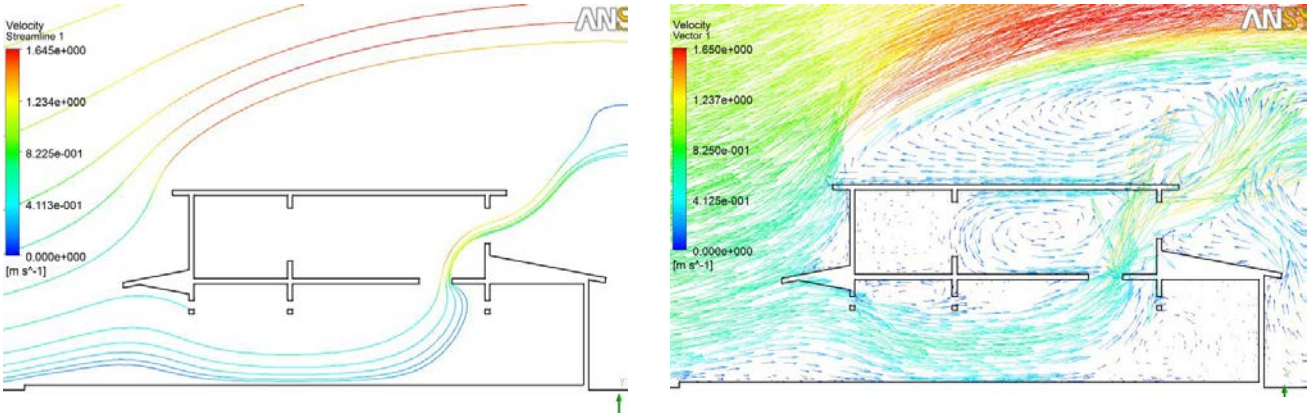

Figure 3. Simulation Mr Ari's House without "*Keongan*" as Roof Ventilation

Mr. Sukadi's House
Simulations conducted with ANSYS software with a wind speed of 1 m / s

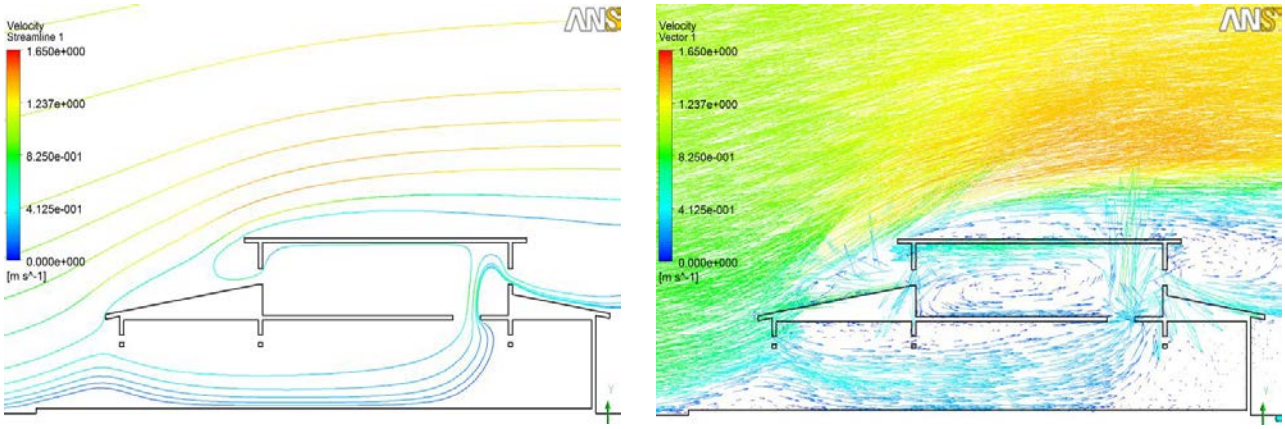

Figure 4. Simulation Mr Sukadi's House with "*Keongan*" as Roof Ventilation

The results of the analysis in the opening roof that serves as a variable, the obtained facts on the ground that the air vent in the roof can reduce air temperature in the room. The movement of air in the roof can occur if there is a hole *keongan*. Roof opening research is very helpful to knew the performance of natural ventilation on occupancy with high density that can harness the potential of roof vents in solving thermal comfort in buildings. The house with a roof vent has a lower temperature and those air movement in the room is higher than the houses that are not equipped with a roof vent.

IV. CONCLUSION

Results of this research is to know the performance of natural ventilation with potential openings that lined with the roof of residential building in order to get around natural ventilation for thermal comfort in the buildings. The air vents in the roof can reduce both air temperature under the roof and in the room. House with the roof vents form *keongan* has a temperature below the lower roof and no air movement under the roof higher than the houses that are not equipped with roof vents or roof *keongan*.

The movement of the wind under the roof occurs because there is movement of air entering through cracks and holes in the keongan roof. The results of this study indicate that, on the orientation of the North, the movement of the wind can be used for roof ventilation. air movement under the roof on a house equipped roof openings or *keongan* ranged from 0.02 to 0.45 m / sec. The village houses are not equipped *keongan* openings in the roof, air movement under the roof in the range of 0.01-0.02 m / s, which would cause a heat trap on the roof heat and heat won't came out of the roof. This will affect the temperature of the room under the roof.

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REFERENCES

[1] Francis Allard & Ghiaus Cristian. (2005) Natural Ventilation in the Urban Environment, assessment and design. Earthscan, London
[2] Aynsley, R.M. (1977) Architectural Aerodynamics. Applied Science publishers LTD, London febrritaa
[3] Awbi, Hazim B. (2003), Ventilation of Building, Spon Press, London.
[4] Arikunto, Suharsimi, (1998), Research Procedure A Practice Approach, Rineka Cipta, Jakarta.
[5] Croome, Derek Clements, (2003), Naturally Ventilated Buildings: Buildings for thr senses, the economy and society, E & FN Spon, London ..
[6] Egan, David (1999), Concepts In Thermal Comfort (Translation), Malang, UNMER Press.
[7] Febrita Yuswinda. (2011) Ventilation Solar Chimney as Pasive Design Alternatives Cooling in Humid Tropical Climate, Journal Lounge Vol 2 No 1, 2011.
[8] Pranoto, Mohammad S (2007), Study of Roof Ventilation Home Based Joglo Mangkurat, Journal of Engineering Planning vol. 3, no. 3, July 2007
[9] Purwanto, LMF, (2006), Effect of roof forms of traditional buildings in Central Java to increase the thermal comfort of the building, the Journal of Architectural Dimensions vol. 34, no. 2, December 2006, 154-160
[10] Roulet, Claude Alain, (2008), Ventilation and Airflow in Buildings, Methods for Diagnosis and evaluation, Earthscan, London.
[11] Samodra, FX. T.B.S. (2005) Thermal Performance Optimization for Javanese Village Houses, Proceedings of the International Seminar SENVAR VI ITB. 19 to 20 September. pp 19-25
[12] Santosa, M. (2000) Specific Responses of Traditional Houses to Hot Tropic, Proceedings SENVAR2000 ITS Surabaya, October 23-24. pp 13-17.
[13] Heru Santoso B, Santosa, M. (2007) Studies on the Building Thermal Environment Variables high density with a roof, walls, Ventilation and Ceiling, Journal of Engineering No1 year Gema X in January 2007.
[14] Santamouris, Mat (1997), Passive Cooling of Building, James and James, London
[15] Sukawi (2010), Linkages Sheath Design Building on Energy Use in Buildings, Energy Seminar Proceedings UNWAHAS Semarang
[16] Sukawi, Dwiyanto Great (2013), Potential Passive Cooling Ventilation Roof Against room on the Development of Small House, Proceedings of the Seminar IPLBI Hasanuddin University, Makassar
[17] Szokolay, S.V. (2004) Introduction to Architectural Science: The Basis of Sustainable Design. Architectural Press, Singapore

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