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Energy Consumption of Indonesian Red Cross (PMI) Building at Wonosobo Regency

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Abstract: Energy use in health buildings is inevitable due to building functions that must protect specific equipment or parts. One of the health buildings, namely the Indonesian Red Cross (PMI) building, serves to draw people's blood. The use of artificial ventilation must be used to support the function of the PMI building. The study aimed to determine the use or energy consumption of the Indonesian Red Cross (PMI) building in the Wonosobo Regency. The study used the field measurement method for one day. The data collection method also uses the observation method to describe the space and activities in the building. Data analysis uses graphs and compares the outside and inside of the building. AC specifications are also displayed to know how much energy is used. The results showed that the energy consumption of air conditioning in the Wonosobo PMI building was not too large, considering that only specific spaces were used. The outside area is quite remarkable and supports the AC setting, which is not too strong.

Keywords: Energy, Health, Building, Highlands, Air Quality

1. INTRODUCTION

At this time, the weather and air temperature around the Wonosobo area are erratic due to changes in climate at the end of this year which often change; this dramatically affects the ventilation of a building, and the weather during the day feels quite hot, which has an impact on the comfort of residents and the function of a building. To overcome this, several buildings or rooms currently use an air conditioner to cool a space. Still, not all of these tools can work optimally in several rooms or facilities due to several factors regarding the placement of devices and the use of materials. Environment and other factors.

The use of air conditioning in buildings results in a waste of energy. Minimizing the use of air conditioning needs to be done so that the use of energy in buildings is not too much. (Sun et al., 2022). The use of air conditioning cannot avoid certain building functions. Some facilities use air conditioning to protect architectural elements or equipment in the building from being damaged quickly. The use of air conditioning is unavoidable for protection against the storage of goods such as blood collection in hospitals or blood collection buildings. The use of AC still has to be done, but it is necessary to optimize the use of AC so as not to make the building cause a waste of energy (Ascione et al., 2018).

Artificial ventilation using air conditioning is intended to create thermal comfort in the building, although there are other functions related to storing goods or equipment. The relationship between building elements and the creation of thermal comfort is very close. Ventilation as part of the building envelope is very influential. Ventilation can be seen from the type of opening, the door's material, or the space's dimensions. Ventilation will make air exchange easy (Priya & Kaja, 2016). However, ventilation will not play much of a role when the building uses an air conditioner that closes or does not provide ventilation. Air exchange does not occur in a room with artificial ventilation.

In addition to ventilation, building materials also influence a building's thermal performance. (Hermawan & Švajlenka, 2021). Using materials for building envelopes and other elements will make a thermal difference at the

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building. Other factors are added by the characteristics of the added features (Yuliani et al., 2021). Thermal measurements in artificially ventilated rooms use thermal variables, including air temperature and humidity (Hermawan et al., 2019). Other thermal-related variables such as wind speed and temperature of solar radiation do not have much effect in the absence of ventilation. Measurement of air temperature and humidity will get the suitability of the thermal conditions in the building with existing thermal standards.

The use of air conditioning in healthy buildings is unavoidable. The use of air conditioning in the Indonesian Red Cross building in Wonosobo Regency needs to be investigated to optimize the use of air conditioning in buildings. The study aimed to determine the consumption of artificial ventilation energy in the Indonesian Red Cross (PMI) building in Wonosobo Regency.

2. METHOD

The research was conducted by measuring the air temperature and humidity variables in certain rooms to determine the comfort of artificial ventilation. Measurements were carried out for one whole day starting at 07.00-18.00 WIB as long as the building was used for activities. The air conditioning is associated with the air conditioner's specifications-data recapitulation using graphs from MS Excel. Data analysis was carried out by connecting air conditioning with the air temperature and humidity found in the measurements. Differences in air temperature and humidity of the outdoor and indoor spaces will be seen and analyzed using thermal comfort standards in highland areas.

3. RESULT AND DISCUSSIONS

The research location is the Indonesian Red Cross (PMI) building, Wonosobo Regency, which is located at Jalan Soepardjo Rustam, Mojotengah, Rw. 6, Andongsili, Mojotengah, Wonosobo Regency, Central Java 56351. The artificial ventilation research focuses on blood donor laboratory rooms and blood collection service rooms that use air conditioners as air conditioners. Blood donor laboratories need to maintain the temperature and quality of the blood that has been taken as well as the blood collection service room which must provide comfort for the perpetrators of the activities in it and the people who visit.

Fig. 1 Building of the Indonesian Red Cross (PMI) Wonosobo Regency

The use of materials in the room influences the air in the room. The walls of the building use plaster bricks. The facility uses various natural stones pasted on the front wall in the front view. Natural stone sticks mainly to the front sight. Using natural stone will prevent direct sunlight from hitting the inner walls. The use of natural stone makes the internal space cooler. Building ventilation in the vestibule as a waiting room allows outside air to enter.

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Fig. 2 Outside View

In the front area, there is a spacious waiting room equipped with chairs as a place to sit to wait in the queue. The waiting room has a void that can be seen on the 2nd floor. The opening also makes the airflow in the waiting room more flexible. The waiting room does not use artificial ventilation. Ventilation in the waiting room is natural ventilation by entering air through the openings of the windows. The natural ventilation in the waiting room looks sufficient because it is coupled with a permanently open entrance. The atmosphere in the outdoor space of the building is not much polluted and is included in the reasonably cold category because it is located in a highland area.

Fig 3. The waiting room

Ceramic materials are widely used in blood donor laboratories and blood collection sites. This material is used on the floor and partly affixed to the room's walls. The characteristic of ceramic material is that it is cold enough to help the air in the room. The concrete material seen in the two rooms is the building's ceiling material because this building has two floors. The blood donor laboratory and blood collection area are on the 1st floor. The characteristics of the heat-absorbing concrete material make the temperature inside the room feel hot when the air temperature outside is high.

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Fig 4. Inner Room

The use of air conditioning is not visible in all indoor spaces. The placement of air conditioners in the laboratory room for blood collection and blood donation is intended not to affect the blood drawn too much due to the high air temperature. Patients who do blood draws also become more comfortable placing the air conditioner under the room's ceiling. The use of AC is quite good considering that only two rooms use AC so that it can save energy use.

Fig 4. AC Laying

Data recapitulation of air temperature and humidity is carried out and compared between air temperature and humidity inside and outside the room. The graph shows that the difference in air temperature and humidity in the outdoor space tends to be higher than the air temperature and humidity in the indoor air.

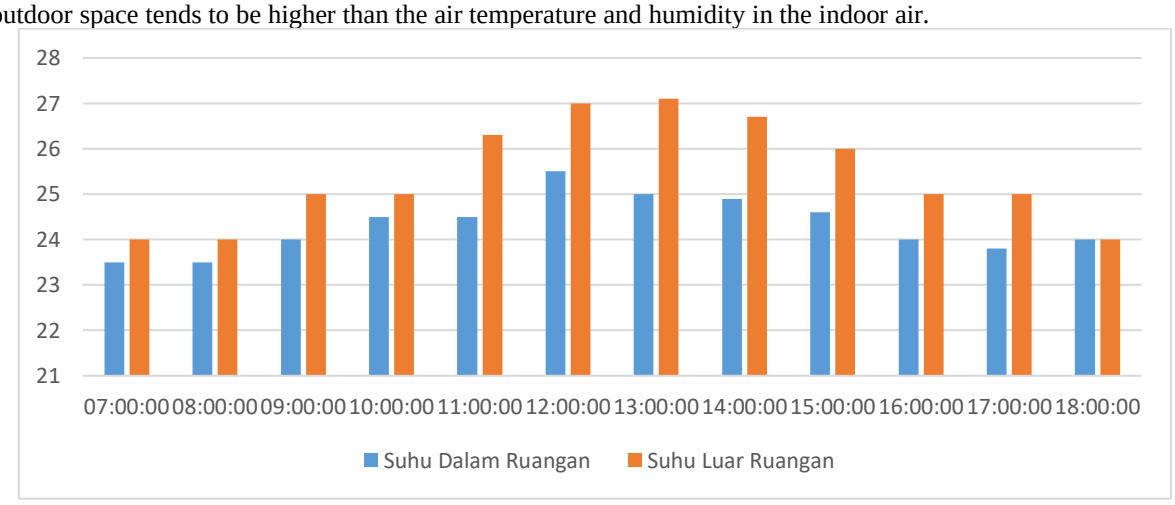

Fig 3. Comparison of Air Temperature in Blood Donation Laboratory Room with Outdoor Room Air Temperature

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The highest air temperature in the room is 25.5oC, which is at noon. The lowest indoor air temperature is 23.5oC, namely at 07:00 AM & 08:00 AM. The average indoor air temperature is 23.75oC. The highest outdoor air temperature is 27.1oC, which is at 01:00 PM. The lowest outdoor air temperature is 24oC, namely at 07:00AM, 08:00AM & 06:00PM. The average outdoor air temperature is 24oC.

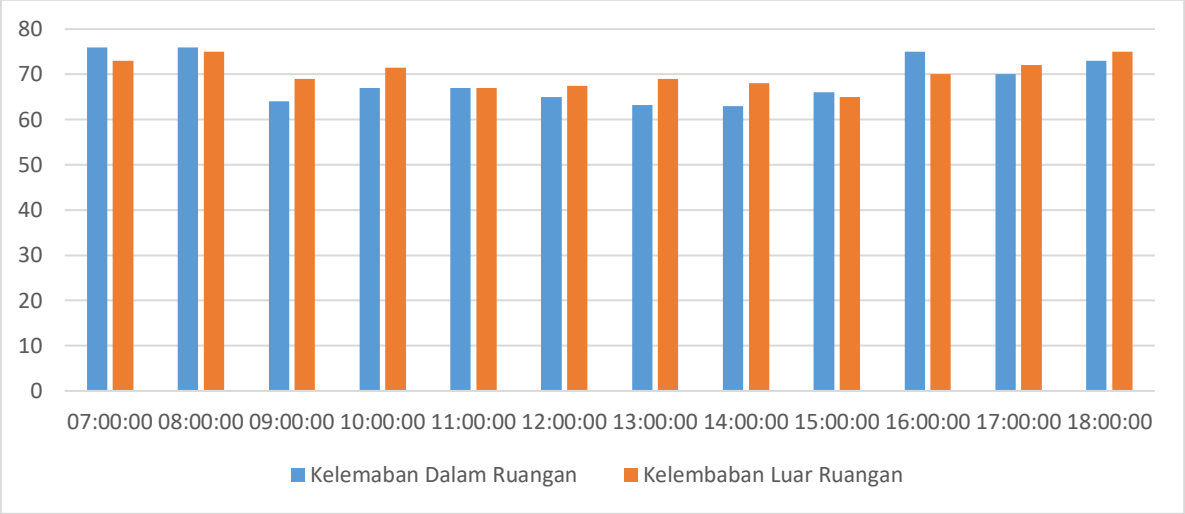

Fig 4. Humidity Comparison of Blood Donation Laboratory Room with Outdoor Humidity

The highest indoor air humidity is 76 at 07:00 AM & 08:00 AM. The lowest humidity in the room is 63% at 02:00 PM. The average indoor air humidity is 74.5%. The highest outdoor humidity is 75% at 08:00AM & 06:00PM. The lowest outdoor humidity is 65% at 03:00 PM. The average outdoor humidity is 74%.

Air temperature in the Blood Donor Laboratory Has a temperature provision (of 18-24oC). Artificial air conditioning is quite effective in maintaining the average air temperature of the room to 23.75oC; there are 3 AC cooling devices used in this room, and each has a capacity of 1, 5PK with a total room area of 72m2. AC specifications are AC Panasonic 1 PK, Air circulation: 10.4m3/minute, Power consumption of 1020 Watt, Product weight: 8 kg, Cooling capacity: 12,000 But/h. There is no window ventilation in this room, none of which is used; this serves to streamline the function of the air conditioner and maintain the temperature of the air and dirt that might enter the air from outside.

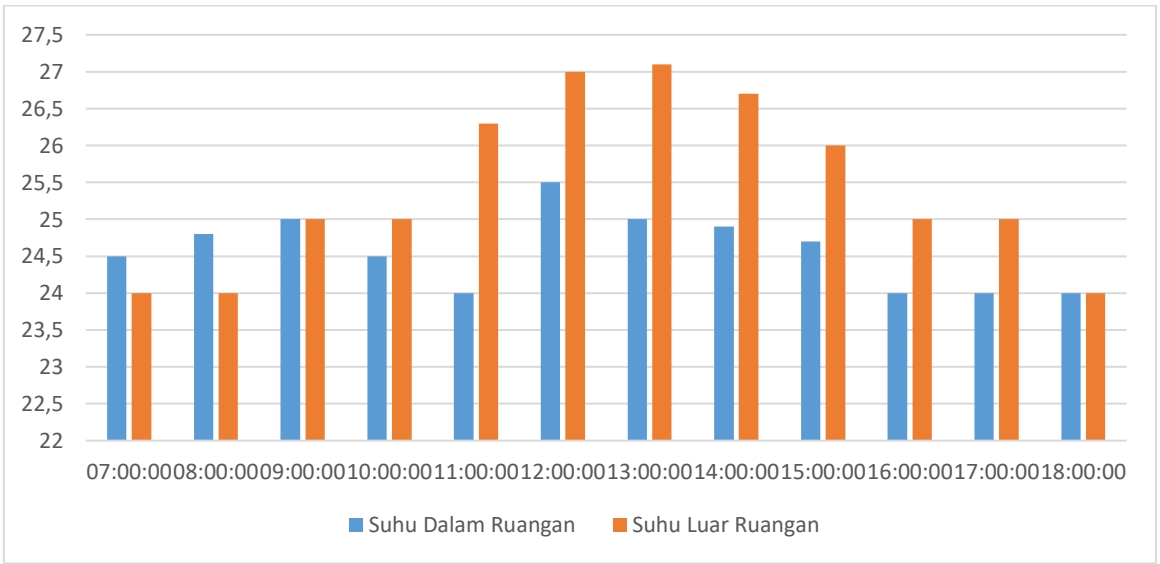

Fig 5. Comparison of Air Temperature in Blood Collection Room with Outdoor Air Temperature

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The highest air temperature in the room is 25.5oC. The lowest air temperature in the room is 24oC. The average indoor air temperature is 24oC. The highest outdoor air temperature is 27.1oC at 01:00 PM. The lowest outdoor air temperature is 24oC, namely at 07:00AM, 08:00AM & 06:00PM. The average outdoor air temperature is 24oC.

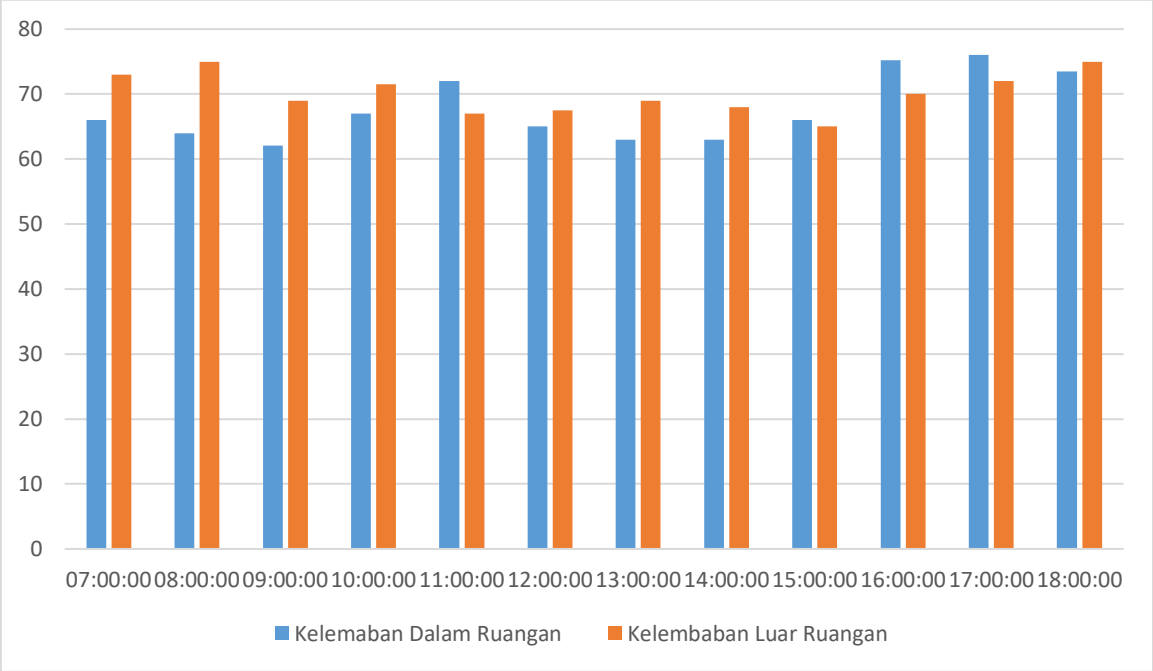

Fig 6. Comparison of the Humidity of the Blood Collection Room with the Humidity of the Outdoor Room

The highest indoor air humidity is 76%. The lowest indoor air humidity is 62.1%. The average indoor air humidity is 69.75%. The highest outdoor humidity is 75% at 08:00 AM & 06:00 PM. The lowest outdoor humidity is 65%; at 03:00 PM—the average outdoor humidity is 74%. The air temperature in the Blood Drawing Room has an average temperature of 24oC; this room is public, and the users of this room are people who are donating blood; taking blood takes around 10-15 minutes which makes this room must provide comfort to activities and people who visit the area. Inside. The use of artificial air conditioning in this room has 1 unit, namely AC with a capacity of 2PK, but the use of AC in this room is only limited when needed; the window ventilation in this room is still enabled when required. AC specifications are 2 Pk Panasonic air conditioners, air circulation: 19.7m3/minute, power consumption 1660 watts, product weight: 12 kg, cooling capacity: 18.000 But/h.

4. CONCLUSION

Regarding artificial ventilation in the laboratory room for blood donation and blood collection, this makes us understand more about the conditions we have been living in regarding artificial ventilation using the AC itself so that we can determine which artificial ventilation in the PMI Wonosobo room is ideal and practical with the room. In its implementation, the ventilation in a room should pay attention to the location of the ventilation, the function of artificial ventilation, the amount of artificial ventilation, and so on, so that the ventilation can function optimally to be able to create an ideal room atmosphere.

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