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Planning of Air Conditioner Cooling Load in the Dean Room of the Faculty of Engineering and Information Technology University of PGRI Semarang

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Abstract. *The specification of the cooling load or chiller in the FTI UPGRIS dean's room currently requires a review of the distribution of cooling air in the room due to the number of electronics and occupants in the room and the size of the air conditioner. Therefore, the room must be taken into account to prevent insufficient cooling load, As a result, it is impossible to reach the desired temperature and humidity set. The FTI Dean's room has an air conditioner with a cooling capacity of 1 unit. It should be able to cover the amount of cooling in the room. To calculate the cooling load borne by the room of the Dean of the FTI UPGRIS, an analysis of the calculation of the cooling load was carried out to determine the number of cooling units needed to provide sufficient cooling in the Dean Room of the FTI UPGRIS. Data collection techniques obtained from the results of research in the room used quantitative research. quantitative data that the largest load is the sensible load 322753.21 Btu/hr, and the latent load is 47152.52 Btu/hr with the total cooling load 369905.73 Btu/hr + 5% Safety Factor (SF) 388.401.01 Btu/hr at 16.00 WIB. Why does the highest load occur at 13.00 WIB, this is due to the maximum load or the peak of the cooling load in the FTI Dean's room. And in terms of the load density of the FTI Dean's room of 388,401.01 Btu/hr divided by the building area of the FTI Dean's room of 530.76 ft^2, the result is that the cooling load density is 731.78 (Btu/hr) per ft^2. From research in the FTI Dean's room, the result was 113.83 Kwatt. The selection of AC units is adjusted to the size of the room, the larger the room that is cooled in the FTI Dean's room, 2 AC units are installed with a power of 1.5 pk with a capacity of 12,000 Btu/hr.*

Keyword : *Cooling Load Analysis, Colling load, Heating load, Air conditioner*

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INTRODUCTION

Background

In conditions where the ambient temperature is low, humans will try to get warm or burn more heat to warm themselves. Likewise, if someone is in a room with high air temperature conditions, it will result in that person being less comfortable and unfocused, so that air conditioning equipment is needed to achieve the ideal temperature and humidity in order to create a sense of comfort.

The specification of the cooling load or chiller in the FTI UPGRIS dean's room currently requires a review of the distribution of cooling air in the room due to the number of electronics and occupants in the room and the size of the air conditioner. Therefore, the room must be taken into account to prevent insufficient cooling load, As a result, it is impossible to reach the desired temperature and humidity set. The FTI Dean's room has an air conditioner with a cooling capacity of 1 unit. It should be able to cover the amount of cooling in the room. To calculate the cooling load borne by the room of the Dean of the FTI UPGRIS, an analysis of the calculation of the cooling load was carried out to determine the number of cooling units needed to provide sufficient cooling in the Dean Room of the FTI UPGRIS.

Problem Identification

1. The lack of cooling comfort in the FTI UPGRIS Dean's room, this will affect the occupants in the UPGRIS FTI Dean's room.
2. The calculation of the load on the air conditioner in the Dean's room, FTI UPGRIS, is not quite right, so that it affects the occupants in the Dean's room, FTI UPGRIS.

Problem Limitation

1. Factors causing the comfort of the Dean of the FTI UPGRIS that affect the performance of the Dean while in the room of the Dean of the FTI UPGRIS
2. Calculation of the cooling load in the FTI UPGRIS Dean's room

Problem Formulation

1. How to get the maximum calculation results with the standard cooling load used in the FTI UPGRIS Dean Room?

Research Objectives

1. Obtain maximum calculation results with the standard cooling load used in the Dean Room of the FTI UPGRIS.

THEORETICAL FOUNDATION

Laws of Thermodynamics

1. Zeroth Law of Thermodynamics
   Says that two systems are in equilibrium with a third system, then the three systems are in equilibrium with each other
2. First Law of Thermodynamics
   is an example of the law of conservation of energy. That is, energy can neither be created nor destroyed.
3. Second Law of Thermodynamics
   According to the principles of physics, it is impossible to build a heat engine that runs in cycles other than simply converting the heat of the container into simple mechanical energy.
4. Third Law of Thermodynamics
   Let's say a system reaches absolute zero temperature (temperature in kelvin) then all processes will stop and the entropy of the system will reach a minimum value.

Room Cooling Load

Its occupants are protected from changing external conditions. Rooms with good interior conditions and inexpensive maintenance are desirable or important criteria in the design of a building. The degree of cooling effect produced by the cooler depends on the heat load in the room.

Basic Principles of Cooling System

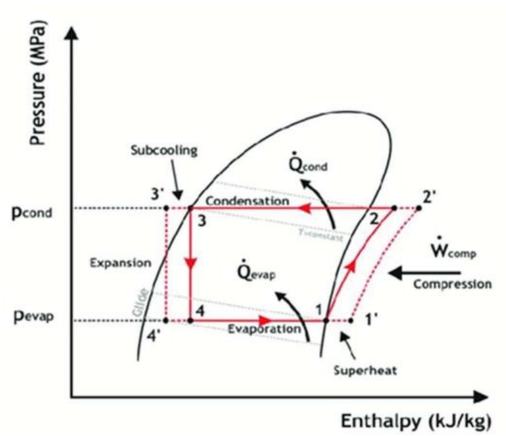

FIGURE 1. PH Diagram

Process 1-2: The liquid refrigerant in the evaporator absorbs heat from its surroundings, usually air, water or other process fluid. During this process, the liquid changes its form from the other process fluids. During this process the liquid changes its state from liquid to gas, and at the outlet of the evaporator this gas is fed with superheated gas.

Process 2-3 : Superheated steam enters the compressor where the pressure is increased. The temperature will also increase, because some of the energy used for the compression process is transferred to the refrigerant.

Process 3-4: high pressure gas passes from the compressor to the condenser. The initial part of the refrigerant process removes heat from the superheated gas before it is returned to the liquid state. The refrigerant for this process is usually achieved using air or water. a further drop in temperature occurs in the piping and fluid intake work, so that the coolant is cooled to a lower level as it enters the expansion device.

Process 4-1 : The cooled high pressure liquid passes through an expansion apparatus, which reduces pressure and controls flow to the condenser and must be able to dissipate the combined heat entering the evaporator and condenser

RESULTS AND DISCUSSION

Room Data

1. Height : 3.8 M
2. Width : 5.95 M
3. Length : 8.45 M

4. Walls : masonry + cement plaster + multiplack
5. Floor : ceramic
6. Ceiling : gypsum
7. Door : Aluminium frame + glass
8. Window : window size 1.08m x 0.47m
9. Lamp : Neon TL 4 Pieces 18 Watt
10. Occupants : 7 people
11. Laptops : 4 pieces
12. Other equipment : cupboards, tables, chairs
13. Type of building : FTI Dean's Room

TABLE 1 Room Dimension

Object	Long (m)	Wide (m)	Tall (m)	Area (m^2)	Volume (m^2)
FTI Dean's Room	8,95	5,51	3,8	49.31	187,39

External Load

This external load, which includes wall loads, roof loads, glass loads, floor loads and door loads, comes from outside the conditioned space or is directly related to the environment.

Internal Load

Internal loads are cooling loads that come from inside the room of the Dean of FTI UPGRIS and both conditioned and unrelated to the external environment. Internal loads consist of occupant loads, lighting, and electronic equipment loads.

Room Total Heat Gain

Room total heat gain results obtained include reasonable room thermal load (RSHG) and room latent thermal load (RLHG), both external and internal.

TABLE 2

Time	RSHG	RLHG	RTHG
	(Btu/hr)	(Btu/hr)	(Btu/hr)
09.00	99114,9	165943,12	265058,02
11.00	98541,32	165943,12	264484,44
13.00	156810,09	165943,12	322753,21

Outside Air Total Heat Gain

Outside air total heat gain The gain is calculated as the total actual and projected ventilation load. The findings of the room's potential ventilation load and the overall reasonable ventilation load are shown in the table below.

TABLE 3

Time	OASH	OALH	OAHG
	(Btu/hr)	(Btu/hr)	(Btu/hr)
09.00	26120,77	13649,13	39769,9
11.00	26889,03	14495,15	41384,18
13.00	30730,32	16422,20	47152,52

Grand Total Heat Gain

The total heat gain is equal to the sum of the heat gains of the room and the total heat of the outside air. From the Supplier Air Conditioning System Design Manual, it was determined that a safety aspect was added to the overall heat.

TABLE 4

Time	TSH	TLH	GTH	GTH+SF	GTH+SF
	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(kWatt)
09.00	265058,02	39769,9	304827,92	320069,31	93,803
11.00	264484,44	41384,18	305868,62	321162,05	94,123
13.00	322753,21	47152,52	369905,73	388401,01	113,83

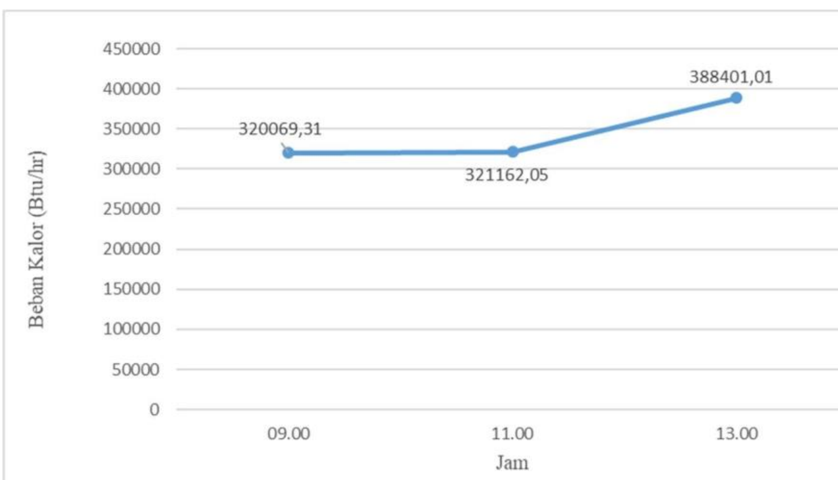

FIGURE 2.

SUMMARY

1. From the calculation of the cooling load that has been carried out, the total cooling load in the FTI Dean's room is 388,401.01 (Btu/hr) or the equivalent of 113.83 Kwatt.
2. From the research in the FTI Dean's room, the results were 113.83 Kwatt. The size of the room affects the selection of AC units, the larger the cooling room at the FTI dean, the installation of 2 1.5 horsepower AC units with a capacity of 12,000 Btu/hr.

REFERENCES

Ansi/Ashrae. (2004). ANSI/ASHRAE 55:2004 Thermal Environmental Conditions for Human Occupancy. *Ashrae*, *2004*, 30.

Duarte, M. V., Pires, L. C., Silva, P. D., & Gaspar, P. D. (2017). Experimental comparison between R409A and R437A performance in a heat pump unit. *Open Engineering*, *7*(1), 77–90. https://doi.org/10.1515/eng-2017-0011.

Gunawan, B., Budihardjo, Juwana, J. S., Priatman, J., Sujatmiko, W., & Sulistiyanto, T. (2012). Buku Pedoman Energi Efisiens.

Harahap, S., Hamid, A., & Hidayat, I. (2014). Perhitungan Ulang Beban Pendinginan Pada Ruang Auditorium Gedung Manggala Wanabakti Blok III Kementerian Kehutanan Jakarta. *Program Studi Teknik Mesin, Fakultas Teknik Universitas Mercu Buana, Jakarta*, 149–154.

Kurniawati, A., & Doloksaribu, G. (2009). *Analisa Perhitungan Beban Pendingin di Tower Universitas Mercu Buana Lantai 5 dan Lantai 6*. 246–254.

Pertiwi, T. B., & Ahyadi, H. (2019). Analisis Beban Pendingin Pada Ruangan Data Center / Server PT XX Di Gedung Summitmas II. *Sainstech: Jurnal Penelitian Dan Pengkajian Sains Dan Teknologi*, *29*(1), 39–47. https://doi.org/10.37277/stch.v29i1.318.

Ridhuan, K., & Rifai, A. (2017). Analisa kebutuhan beban pendingin dan daya alat pendingin AC untuk aula kampus 2 UM Metro. *Jurnal Program Studi Teknik Mesin*, *2*(2), 7–12.

Rudoy, D. W. (1791). Ashrae Cooling and Heating Load Calculation Manual.