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Comparative Analysis of Different Three Types of Room Heater for Thermal Effect

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Abstract*— The present work experimentally carried the study of comparative analysis of different type of room heater for space heating and thermal comfort. In cold climate the human being is required thermal comfort. In rural areas, humans are using the domestic heater, blower and other different types of heater for thermal comfort. Although sometimes used of these types of heater results oxygen level is down and so it is harmful to health. A comparative analysis was done in this work to reduce these problems. In these experiments, three different types of heater were used, and in the present work suggested the best type of heater for room heating in cold climate. A room is heated with a volume of 3 x 2.4 x 3.65 m3 for thermal comfort, the temperature and humidity is measured and calculates the total temperature rise and humidity drop of the room. The comfort and combine study of performance of blower, rod heater and circular heater was done in the Ramanujan hostel room at Kamla Nehru Institute of Technology, Sultanpur during night. The study was confined to 9 PM to 4 AM from January 2019 to March 2019. The experimental study was done in night so solar radiation by sun is negligible and the reading is effectively observed. Therefore, the three cases were carried experimentally for room heating in cold climate and a comparative analysis is done of these three cases (blower, circular heater and rod heater).

Index Terms*— Space heating; thermal effect; temperature; humidity; room heater etc.

I. INTRODUCTION

India is in the northern part of the globe, where 24 hours variation of sun. The position of sun changes continuously. The radiation intensity is not uniform. In Indian continent, there is lots of variety of seasonal variation found. It is mandatory to design effective comfort zone for the human and other species. Rooms are normally made of bricks and it is not adjustable with variation of temperature throughout the year. So artificial room heating/cooling arrangement was accommodated the variability of the temperature. Space heating in room is an important process for thermal comfort in cold climates for indoor air quality. Many researchers are working in this field to analyze the space heating by different types of domestic heater for thermal comfort. Some are working with to heat the room by changing various parameters and improve the indoor air quality. In this work three different types of heater (domestic coil heater, rod heater and blower) are used to heat the room for thermal comfort.

Thermal comfort in buildings is an important property for the quality of the indoor environment. Cedric hemmer, Guillaume Polidori and Catalin Popa have optimized the room temperature by variation of emissivity of heating elements for space heating. They have studies of emissivity variation of different electric heater components to optimize the surface temperature of an electric heater for an industries purpose. For this application a numerical study is done of an electric heater with convection and radiation in a heated room. Finally all the heating elements that make up electric heating device must have low emissivity [1].

The utilized the waste heat from a split type air conditioning to heating a drying cabinet for drying the clothes in well-insulated cabin. A drying cabinet with a volume of 1 m^3 is heated by hot exhaust gases of split air conditioning. In which utilized the waste heat from air conditioning and also heating the space by hot exhaust gases [2].

The heating the space by a hydronic heat emitter (radiator) that behaves nonlinearly. They are studying on applying model predictive control scheme for space heating operation. These are used to heat a room by radiator which is a heat emitter radiator. They were investigating the effect of nonlinear dynamics of a hydronic heat emitter on the demand response potential of model predictive control scheme for space heating [3].

This article focuses on describing how the installation of a new heater in southern Chile redefines domestic practices, non-domestic practices, and infrastructures in which heating is organized in everyday life. We analyze this process by developing the concept of heating ecology, which describes domestic heating as the result of the dynamic interrelationship among in-home practices, outdoor practices, and infrastructures [4 and 5].

The actual world tendency is towards the reduction of fuel consumption and carbon dioxide emission. They were implemented a prototype and parametric analysis is carried out to test the effect of temperature and mass flow rates on the performance of heat recovery system. Experiments are performed under typical conditions simulating the HVAC operation in cold climates. On the other hand, a generalized procedure of calculation is suggested based on the experimental results. An air conditioning unit of 5.3 kW was

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used in the prototype to generate hot air in the room. It was shown that both the performance and efficiency of the heat recovery system proposed increase with both the condenser cold and the duct hot flow rates [6 and 7].

The present work analyzed experimentally the comparative analysis of three different types of room heater (blower, circular heater and rod heater) for space heating in winter. In these three cases is carried out for optimized the temperature rise and minimize the humidity drop. In case of blower the room temperature rise is reached to 8.55^0C and humidity drop is 8%. And the in case of circular heater and rod heater the temperature rise and the humidity drop are 4.73^0C, 8% and 4.36^0C, 9% respectively. Therefore from all three cases, the maximum temperature rise and minimum humidity drop are experimentally observed in case of the blower. The blower is best for room heating and thermal comfort comparison to two other heaters.

II. EXPERIMENTAL PROCEDURE

The comfort and combine the study of performance of blower, rod heater and circular heater was done in the Ramanujan hostel room at Kamla Nehru Institute of Technology during night. The study was confined to 9 PM to 4 AM from January 2019 to March 2019. The capacity of room was 3 x 2.4 x 3.65 m^3 concrete room. The insulation of room was created with thermocouple material. The specification thermocol mentioned below.

In which three different types of heater is a blower, circular and a rod-type domestic heater with same power consumption of 1000W is used. The room is insulated with insulation material (Thermo coal). The room of north sidewall is in surrounding and east-west wall is attached to other room wall and south side wall with a gate to the surrounding. All the wall, gate and windows are fully insulated with insulation material.

The L- type thermocouple with six nodes and 4 K- type thermocouple is used to measure the temperature at different point of the room then after an average temperature of room is calculated. And a weather analogue watch is used to measure the humidity of the room.

In the experimental setup, there are two main parameters (Temperature and humidity) is measured of the room of different type of heater and decide the west heater for space heating of room for thermal comfort oh human being.

The experiments are done in the night because to avoid the radiation of sunlight and to approach the best reading of the experiments..

A. Assumption

- Heat transfer through the room wall is negligible.
- Room is fully insulated
- Heat transfer in the room by convection and radiation only.
- The initial temperature throughout the room is uniformly distributed.
- No radiation by the sun.
- Power consumption by the blower fan is the negligible comparison to heating element
- Same power consumption rate of blower circular domestic heater and rod heater is 1000W.

B. Figures

Space heating of the room, the three cases are experimentally done on 9 PM to 4 AM. In case of blower, the room is heated with initial temperature 24.30^0C and humidity 62 %. The temperature of room is slightly increased. In which heat transfer of the room by convection and radiation only and heat transfer by conduction is negligible. And after 8 hours, the temperature of the room is reached to 32.85^0C and humidity 54%. While in case of a domestic circular heater, the room is heated with initial temperature 25.27^0C and humidity with 60%. In this case the room is also heated till 8 hours, and the temperature of the room is reached to 30^0C and humidity 52%.

And the room is heated by a domestic rod heater with initial temperature 26.10^0C and humidity 59%. In this case, the room is also heated up to 8 hours, and the temperature of the room is reached to 30.46^0C and humidity ratio 50 %

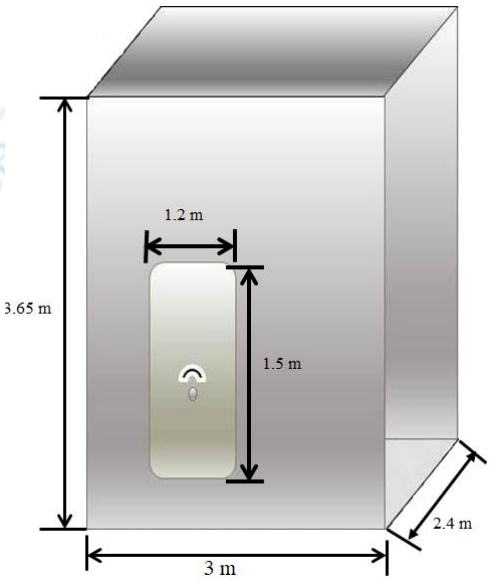

Fig: 1. Heating Room

III. RESULT AND DISCUSSION

In this work three different type of heater for space heating of room were studied experimentally. Thus the three total cases were carried out throughout the experiments. The result is analyzed in term of thermal comfort of room and the temperature rise of the room as well as humidity dropped of the room. The three cases are done for thermal comfort of room as follows:

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- Space heating by blower
- Space heating by circular domestic heater
- Space heating by rod heater

Power consumption rate all three cases is constant and power supply ac voltage 230-250V. And we assume room is fully insulated.

Case 1- In the case 1, a 1000W power rated blower with 230-250V were used to heat the room, the observation table is shown in table 3.1.

Table 3.1 Observation table for 1000W blower

Time	Surface Temp. of coil (^{0}C)	Room Temperature (^{0}C)	Humidity (%)
9 PM	24.7	24.30	62
10 PM	103.6	30.24	59
11 PM	108.4	31.40	57
12 PM	111.8	32.12	56
1 AM	112.2	32.50	55
2 AM	112.6	32.70	54
3 AM	113.1	32.85	54
4 AM	113.2	32.85	54

Now the temperature rise and humidity dropped is calculated as follows:

Initial temperature of the room $(T_i)_b$

$(T_i)_b = 24.30^0$C

Final temperature of room after 8 hours $(T_f)_b$

$(T_f)_b = 32.85^0$C

Temperature rise of room after 8 hours $(\Delta T)_b$

$(\Delta T)_b = (T_f)_b - (T_i)_b = 32.85 - 24.30$

$(\Delta T)_b = 8.55^0$C

Initial humidity of room$(\Phi_i)_b$

$(\Phi_i)_b = 62$ %

Final humidity of room after 8 hours $(\Phi_f)_b$

$(\Phi_f)_b = 54\%$

Dropped in humidity of room after 8 hours

$(\Delta\Phi)_b = (\Phi_i)_b - (\Phi_f)_b = 62 - 54$

$(\Delta\Phi)_b = 8\%$

Hence in this case the total temperature rise and humidity drop are 8.55^0C and 8% respectively after 8 hours of room heating.

Case 2- In the case 2, a circular domestic heater were used to heat the room with power consumption rate of 1000W; the observation table of circular domestic heater is shown in table 3.2.

Table 3.2 Observation table for 1000W circular heater

Time	Surface Temp. of coil (^{0}C)	Room Temperature (^{0}C)	Humidity (%)
9 PM	24.8	25.27	60
10 PM	200.6	27.95	58
11 PM	210.7	28.6	56
12 PM	220.3	29	54
1 AM	225.4	29.85	53
2 AM	226.2	29.93	52
3 AM	226.5	30	52
4 AM	226.6	30	52

Now the temperature rise and humidity dropped is calculated as follows:

Initial temperature of the room $(T_i)_c$

$(T_i)_c = 25.27^0$C

Final temperature of room after 8 hours $(T_f)_c$

$(T_f)_c = 30^0$C

Temperature rise of room after 8 hours $(\Delta T)_c$

$(\Delta T)_c = (T_f)_c - (T_i)_c = 30 - 25.27$

$(\Delta T)_c = 4.73^0$C

Initial humidity of room$(\Phi_i)_c$

$(\Phi_i)_c = 60$ %

Final humidity of room after 8 hours (Φ_f)

$(\Phi_f)_c = 52\%$

Dropped in humidity of room after 8 hours

$(\Delta\Phi)_c = (\Phi_i)_c - (\Phi_f)_c = 60 - 52$

$(\Delta\Phi)_c = 8\%$

Hence in this case the total temperature rise and humidity drop are 4.73^0C and 8% respectively after 8 hours of heating of room.

Case 3- In the case 3, a rod heater were used to heat the room with 1000W power rated heating coil; the observation table of this case is shown in table .3

Table 3.3 Observation table for 1000W rod heater

Time	Surface Temp. of coil (^{0}C)	Room Temperature (^{0}C)	Humidity (%)
9 PM	26.5	26.1	59
10 PM	148.2	29.13	54
11 PM	198.3	29.65	52
12 PM	200.2	29.73	51
1 AM	202.5	30.25	50
2 AM	204.2	30.30	50
3 AM	205.5	30.46	50
4 AM	205.6	30.46	50

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Now the temperature rise and humidity dropped is calculated as follows:

Initial temperature of the room $(T_i)_r$
$(T_i)_r = 26.1^0C$
Final temperature of room after 8 hours $(T_f)_r$
$(T_f)_r = 30.46^0C$
Temperature rise of room after 8 hours $(\Delta T)_r$
$(\Delta T)_r = (T_f)_r - (T_i)_r = 30.46 – 26.1$
$(\Delta T)_r = 4.36^0C$
Initial humidity of room$(\Phi_i)_r$
$(\Phi_i)_r = 59$ %
Final humidity of room after 8 hours $(\Phi_f)_r$
$(\Phi_f)_r = 50\%$
Dropped in humidity of room after 8 hours $(\Delta\Phi)_r$
$(\Delta\Phi)_r = (\Phi_i)_r - (\Phi_f)_r = 59 – 50$
$(\Delta\Phi)_r = 9\%$

Hence in this case the total temperature rise and humidity drop are 4.36^0C and 9% respectively after 8 hours heating of room

IV. COMPARATIVE ANALYSIS OF ALL THREE CASES

The comparative analysis of all three cases are carried out the studied experimentally in shown in table 4.1, in this table the three cases is occurred of all different three type of heater. The temperature rise and humidity drop of all three cases is get from observation tables 3.1, 3.2 and 3.3.

Table 4.1 Comparative table for blower, circular heater and rod heater

Cases	Temperature rise (ΔT) after 8 hours in ^0C	Humidity drop (ΔΦ) after 8 hours in %
Case 1 (Blower)	8.55	8
Case 2 (Circular heater)	4.73	8
Case 4 (Rod heater)	4.36	9

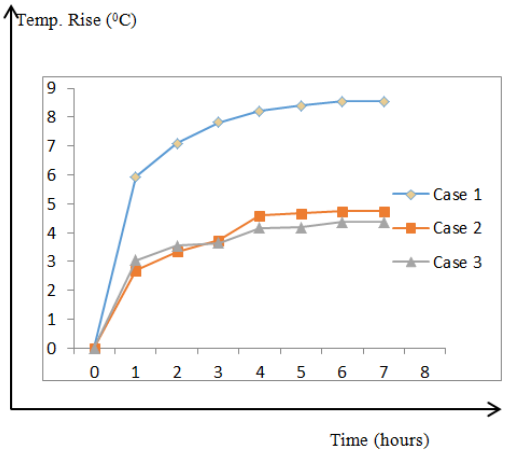
Now in case 1, from table 4.1 the temperature rise and humidity drop of the room is respectively; 8.55^0C and 8%. However this is the optimum temperature rise compare to two other cases.

And in case 2, the temperature rise of the room is decreased but humidity drop is constant compared to case 1. In this case the temperature rise and humidity is observed that respectively, 4.73 and 8%.

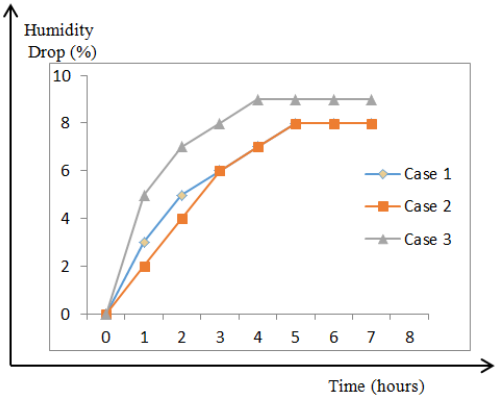
In case 3, the temperature rise and humidity drop is experimentally carried out respectively 4.36^0C and 9%.

Therefore, the studied of all three cases of three different heaters (blower, circular heater, rod heater) experimentally.

In case 1, comparison to two other cases the maximum temperature rise and minimum humidity drop are 8.55^0C and 8% respectively. Furthermore we observed experimentally, the room heating by blower is best comparison to circular heater and rod heater.



Graph 4.1 Variation of temperature for different three cases with respect to time in hour.



Graph 4.2 Variation of humidity for different three cases with respect to time in hour.

V. CONCLUSION

In the present work, a comparatively analysis have been experimentally done of room heating for thermal comfort. The three cases of room heating are done and find out best case for thermal comfort. The experimentally and numerically have been studied of all three cases (blower, circular heater, room heater). Results show the temperature rise and humidity drop with all three cases. In case of first, the temperature rise is higher than other two cases and the humidity drop is less than one case and equals to other case. In case 1, the maximum temperature rise and minimum humidity drop have been 8.55^0C and 8% respectively. In conclusion, the space heating by blower with 1000W power consumption is better than other rod heater and circular domestic heater with same power consumption rate for thermal comfort in cold climate.

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