Abstract: In this paper the principle concern contextual investigation on cooling load figuring and comfort for understudies of Parthivi Building Institute, focal aerating and cooling framework is a procedure of controlling the air temperature, relative moistness, ventilation, air development and air cleanliness of a given space keeping in mind the end goal to give the inhabitants an agreeable indoor temperature in address lobbies of the designing organization. The goal of this paper is to cooling load estimation of the designing establishment address corridors (first floor) and air conditionings utilized as a part of address lobbies for effectively expel from the air smaller scale life forms, tidy, and sediment. So legitimately kept up aerating and cooling framework does not bring about or advance sickness, in spite of superstitions that ventilating is genuinely perilous to one's wellbeing.

Keywords: Cooling load, Human comfort, Lecture hall, Central Air condition, Heat gain.

1. Introduction

The cooling and air-conditioning is a procedure that all the while conditions air; circulates it consolidated with the open air to the melded space; and in the meantime controls and keeps up the required space's temperature, dampness, air development, air cleanliness, sound level, and weight differential inside foreordained points of confinement for the wellbeing and solace of the inhabitants, for item handling, or both [6].

Aerating and cooling Framework comprises of a gathering of parts or gear associated in arrangement to control the ecological parameters. An aerating and cooling framework, by ASHRAE (American Culture of Warming, Refrigerating and Ventilating Engineers) definition is a framework that should finish four destinations at the same time. These goals are to: control air temperature; control air moistness; control air course; and control air quality [2].

Solace Aerating and cooling is a procedure of controlling the air temperature, relative dampness, ventilation, air development and air cleanliness of a given space keeping in mind the end goal to furnish the inhabitants with an agreeable indoor temperature while Cooling framework comprises of a

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside maximum temperature</td>
<td>38°C &amp; 40% RH</td>
</tr>
<tr>
<td>Inside minimum temperature</td>
<td>24.5°C &amp; 40% RH</td>
</tr>
<tr>
<td>Average temperature</td>
<td>31.25°C</td>
</tr>
<tr>
<td>Inside design condition</td>
<td>25°C &amp; 50% RH</td>
</tr>
<tr>
<td>Equivalent temperature difference</td>
<td>6.25°C</td>
</tr>
</tbody>
</table>

In this fig.1 show the average temperature graph data for Bhilai place of Chhattisgarh.
3.1 Solar Heat Gain Through Window Glass

In this section the calculating of solar heat gain through glass of window and the window area is 2.178 m$^2$ of the rooms. The table 2 is shown the solar heat gain calculating with the help of SHGF value different for different window face directions and SC is the shading coefficient.

<table>
<thead>
<tr>
<th>Room No.</th>
<th>No. of Windows facing</th>
<th>Area of window (m$^2$)</th>
<th>SHGF Value (W/m$^2$)</th>
<th>Shading Coefficient, SC</th>
<th>Solar Heat Gain (Watt) $= A\times SHGF \times SC$</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-6</td>
<td>6 NW</td>
<td>2.178</td>
<td>470.25</td>
<td>0.95</td>
<td>5838</td>
</tr>
<tr>
<td></td>
<td>4 SW</td>
<td>2.178</td>
<td>470.25</td>
<td>0.95</td>
<td>3892</td>
</tr>
<tr>
<td>F-7</td>
<td>2 NE</td>
<td>2.178</td>
<td>470.25</td>
<td>0.95</td>
<td>1946</td>
</tr>
<tr>
<td></td>
<td>4 SW</td>
<td>2.178</td>
<td>470.25</td>
<td>0.95</td>
<td>3892</td>
</tr>
<tr>
<td>F-14</td>
<td>6 NW</td>
<td>2.178</td>
<td>520.5</td>
<td>0.95</td>
<td>6462</td>
</tr>
<tr>
<td></td>
<td>4 NW</td>
<td>2.178</td>
<td>520.5</td>
<td>0.95</td>
<td>4308</td>
</tr>
<tr>
<td>F-15</td>
<td>2 NE</td>
<td>2.178</td>
<td>520.5</td>
<td>0.95</td>
<td>2154</td>
</tr>
<tr>
<td></td>
<td>4 NW</td>
<td>2.178</td>
<td>520.5</td>
<td>0.95</td>
<td>4308</td>
</tr>
<tr>
<td>F-16</td>
<td>2 NE</td>
<td>2.178</td>
<td>520.5</td>
<td>0.95</td>
<td>2154</td>
</tr>
<tr>
<td></td>
<td>4 SW</td>
<td>2.178</td>
<td>470.25</td>
<td>0.95</td>
<td>1946</td>
</tr>
<tr>
<td>F-18</td>
<td>6 SW</td>
<td>2.178</td>
<td>470.25</td>
<td>0.95</td>
<td>3892</td>
</tr>
<tr>
<td>F-22</td>
<td>5 NE</td>
<td>2.178</td>
<td>520.5</td>
<td>0.95</td>
<td>5385</td>
</tr>
<tr>
<td></td>
<td>4 SW</td>
<td>2.178</td>
<td>470.25</td>
<td>0.95</td>
<td>3892</td>
</tr>
</tbody>
</table>

3.3 Heat Gain Through Roof

Roof of the class room material is used concrete. On ground floor the heat gain from the roof is zero, because equivalent temperature difference is zero. Roof thickness is 0.2032 m with plaster 0.012 mm thickness.

Transmission co-efficient of roof, $U_r = 1.66$ W/ m$^2$K

$U_r = \frac{1}{k_{tr} + \frac{1}{k_{tp}}}$

$U_r = \frac{1}{0.2032 + \frac{0.012}{0.2910}} = 0.7792$ W/m$^2$.K

Total $= 1.4012$ W/m$^2$.K
The equivalent temperature difference of roof (from table) $T_r = 18.25 \, ^\circ C$. Total roof area of all first floor room (F-6, F-7, F -14, F -15 , F -16 , F -18 and F -22 ), $A_r = 719.53 \, m^2$

Total heat gain through roof

\[ U \cdot A \cdot T_r = 1.4012 \times 719.53 \times 18.25 = 18397.123 \, W. \]

3.4 Heat Gain Through Appliances

Heat gain from fluorescents

\[ = \text{Watts of fluorescents} \times 1.25 \times \text{No. of fluorescents} \]

\[ = 40 \times 1.25 \times 28 = 1400 \, W \]

Where, 1.25 is factor considering the heat gain from choke.

Heat gain from fans

\[ = \text{Watts of Fan} \times \text{No. of Fans} \]

\[ = 60 \times 28 = 1680 \, W \]

Total heat gain from Appliances (fluorescents and fans):

\[ = 3080 \, W \]

3.5 Heat Gain from Occupancy

Number of people in each class room = 66 (Take avg.)

Number of class room = 7

Duration of occupancy = 7 hr.

Nature of activity – Study

Total number of people = 7\times66 = 462

Average metabolic rate of adult male at 25°C gives

Sensible heat =70 W

Latent heat = 45 W

Total sensible heat gain =70\times462 = 32340 W

Total latent heat gain = 45\times462 = 20790 W

Total heat gain from occupancy = 53130 W

3.6 Infiltration

Infiltration may be defined as the uncontrolled entry of untreated, outdoor air directly into the conditioned space.

Infiltration through doors:

\[ \text{Door size} = 2.83 \times 1.524 \, m^2 \]

\[ \text{Number of doors in each room} = 01 \]

\[ \text{Air wind velocity} = 12 \, km/hr \]

\[ \text{Wood door – average used} \]

To calculate the heat gain through door, we determine $m^3/min/\text{person}$. From table and then psychometric chart determines sensible and latent heat.

\[ m^3/min/\text{person} = 0.09912 \]

\[ \text{Area of the door} = 4.313 \, m^2 \]

From psychrometric chart

At 25°C and 50% RH,

\[ h_i = 51.00 \, kJ/kg \, of \, air \]

\[ v_i = 0.86 \, m^3/kg \]

At 38°C and 40% RH,

\[ h_o = 80.1 \, kJ/kg \, of \, air \]

\[ v_o = 0.90 \, m^3/kg \]

At 31.25°C and 40% RH,

\[ h_{k} = 64 \, kJ/kg \, of \, air \]

Sensible enthalpy gain = $(h_k - h_i) = 13 \, kJ/kg$

Latent enthalpy gain = $(h_o - h_{k}) = 16.1 \, kJ/kg$

Mass of infiltration air/\text{person} ($m_i$) = ($m^3/min \, \text{person}$/ ($v_o$) = $V/v_o$

\[ m_i = 0.09912/0.90 = 0.11013 \, kg/min \]

\[ m_i = 0.001836 \, kg/sec \]

Sensible heat gain (S.H.G) = $m_i \times (h_{k} - h_i) = 0.001836 \times 13 = 23.86 \, W$

Latent heat gain (L.H.G) = $m_i \times (h_o - h_{k}) = 0.001836 \times 16.1 = 29.56 \, W$

Total sensible heat gain (T.S.H.G) = 462 \times 23.86 = 11023.32 \, W$

Total latent heat gain (T.L.H.G) = 462 \times 29.56 = 13656.72 \, W$

Total heat gain (T.H.G) = (T.S.H.G) + (T.L.H.G) = 24680.04 \, W$

Infiltration through window:

\[ \text{Area of window} = A_w = 2.178 \, m^2 \]

At 12 km/hr(200 m/min) average velocity of wind.

From table

\[ m^3/min \, m^2 = 0.067 \]

\[ m^3/min \, (\text{for 1 window}) = 0.067 \times 2.178 = 0.146 \, m^3 \]

\[ \text{Mass flow rate due to infiltration through window} (m_{in}) = 0.146 / 0.90 = 0.162 \, kg/min \]

\[ m_{in} = 0.0027023 \, kg/sec \]

Total number of window = 55

Total number of persons = 462

Sensible heat gain / window = $m_{in} \times (h_{k} - h_i) = 0.0027023 \times 13 \times 1000 = 35.13 \, W$

Latent heat gain /window = $m_{in} \times (h_o - h_{k}) = 0.0027023 \times 16.1 \times 1000 = 43.51 \, W$

Total sensible heat gain (T.S.H.G) = 462 \times 35.13 = 16230.60 \, W$

Total latent heat gain (T.L.H.G) = 462 \times 43.51 = 20101.62 \, W$

Total heat gain (T.H.G) = (T.S.H.G) + (T.L.H.G) = 36332.22 \, W$

3.7 Ventilation

The introduction of outer air for ventilation of conditioned space is necessary to dilute the odours given off by people, smoking of people and other internal air contaminants. The amount of ventilation varies primarily with total number of people, the number of people smoking and the ceiling height.

People give off body odours which require minimum of 0.28 m3 /min/ \text{person} for satisfactory dilution.Number of persons = 462.

\[ \text{Outer air (V_o)} = 462 \times 0.28 = 129.36 \, m^3/min \]

From psychrometric chart

At 25°C and 50% RH,

\[ h_i = 51.00 \, kJ/kg \, of \, air \]

\[ v_i = 0.86 \, m^3/kg \]

At 38°C and 40% RH,

\[ h_o = 80.1 \, kJ/kg \, of \, air \]

\[ v_o = 0.90 \, m^3/kg \]

At 31.25°C and 40% RH,

\[ h_{k} = 64 \, kJ/kg \, of \, air \]

OASH = Outside air sensible heat, OALH = Outside air latent heat, BPF = Bypass factor, ERSH = Effective room sensible heat, ERLH = Effective room latent heat, ESHF = Effective room sensible heat factor.

\[ \text{OASH} = 0.0204 \times V_o \] (Outside temperature - Inside temperature) x BPF

\[ = 0.0204 \times 129.36 \times (38-25) \times 0.52 \]

\[ = 17.84 \, kW = 17840 \, W \]
From psychrometric chart
At 25°C and 50% RH,
Inside humidity \(\omega_i = 0.010\) kg/kg dry air
At 38°C and 40% RH,
Inside humidity \(\omega_i = 0.017\) kg/kg dry air

\[\text{OALH} = 50 \times V_o \text{ (Outside humidity - Inside humidity)} \times BPF\]
\[= 50 \times 129.36 \times (0.017-0.010) \times 0.52\]
\[= 23.54 \text{ kW} = 23540 \text{ W}\]

Moisture removed = 0.0115 - 0.0095 (from psychrometric chart)
\[= 0.002 \text{ kg/kg of air}\]
Moisture removed = 27.82 x 3600 x 0.002 = 200.304 kg/hr

4. Results and Discussion

This results and discussion may be combined into a common section or obtainable separately.

In this paper the lecture hall of the engineering institute is centrally air-cooled than the students living there will feel comfortable by providing uniform comfortable ambient, their working capability will increase, consequently, this will be useful in studying for prolonged hours, which ultimately cater them good-marks and better academic output. This will prove as a boon for their career.

The load calculation has been done for the peak load on the plant that may be encountered during the month of May as a peak summer duration.

Only one centralized air conditioning plant for the both the floor has been suggested with the capacity of nearly 214.59 TR.

5. Conclusion

In this project the lecture hall of the engineering institute is centrally air-cooled than the students living there will feel comfortable by providing uniform comfortable ambient, their working capability will increase, consequently, this will be useful in studying for prolonged hours, which ultimately cater them good-marks and better academic output. This also useful in various departments and offices of the engineering institutes further research.

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References


