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DESIGN & CALCULATION OF DUCT AND COOLER FOR ME-02 CLASSROOM

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Abstract

The primary objectives of this project is to design and implement a efficient duct and cooler system for educational environments. The objective is to provide a comfortable and useful learning environment by improving indoor air quality and temperature management.
The project begins with a thorough analysis of the current classroom conditions, taking into account factors such as space requirements, occupancy, ventilation, and temperature. Based on this research, appropriate design parameters are developed to achieve the optimal cooling and air dispersion. To achieve the intended cooling effect, the necessary air and fan capacity must be determined. In order to ensure that every region of the workplace receives appropriate cooling, proper airflow distribution is essential. choosing fans with the right capacity and effectiveness will assist in maintaining the desired cooling effect.

Introduction

In the current environment, it is imperative to find effective air-cooling systems. To efficiently cool a room, an appropriate fan and duct system must be selected. There is a strong demand for designers that can create strategies for cooling factories and diverse businesses in nations where the outside temperature is over what is comfortable. In order to establish the optimum environment for productive work, it is crucial to thoroughly assess both the internal and exterior aspects of the workplace. In order to get the best cooling performance, our research focuses on analyzing and studying the conditions and aspects linked to duct design and installation. Designing an effective cooling system requires a thorough understanding of the particular requirements of the classroom. By taking into account elements like the size of the classroom, number of peoples and electric appliances, one can create the effective cooling system .

OBJECTIVE

1) To provide Air cooling with reduced power consumption
2) Create a Reliable system
3) Reduce frictional losses
4) Optimum utilization of space
5) Proper air distribution through-out classroom
6) To Reduce noise

LITERATURE SURVEY

1. **Effects of wall admittance changes on duct transmission and radiation of sound." By D.L. Lansing, and W.E. Zorumski**

This paper is concerned with the effect of changes in duct wall acoustic properties on the transmission of sound through ducts. Two special problems are considered. The first problem is that of a rectangular infinite-length duct with airflow and a single change in duct wall acoustic admittance.

2. **"Corrugated-Duct Heat Transfer, Pressure Drop, and Flow Visualization." By J. E. O'Brien and E. M. Sparrow**

In this paper Authors includes some experiments to determine forced convection heat-transfer coefficients and friction factors for flow in a corrugated duct

3. **"Fully Developed Pressure Drop a Triangular Shaped Ducts."By L. W. Carlson and T. F. Irvine**

   In this paper Authors takes the readings of air for pressure drop in hydrodynamic section.

4. **"convective heat transfer in the entrance region of a rectangular duct with two indented sides." By Z.F.DONG and M.A. Ebadian**

In this paper Authors presented a numerical solution to convective heat transfer in the thermal entrance region of rectangular duct with two indented sides.

Heat emitting sources in the classroom

1) Peoples sitting in classroom
2) Numbers of Lights, fans other electrical appliances in the classroom
3) Windows exposed to sun
4) Walls in direct contact with sun
5) Walls not in direct contact with sun
6) Roof
7) Floor

Specifications of the classroom

1) sitting capacity =60 people
2) No of fans =5
3) No of light =4
4) Projector =1
5) No of windows =4
6) No of doors = 2
7) Area of roof = Area of floor=75.80 sq.m.

Heat Load Calculations

Two Types Of Wall Area

A) Gross Wall Area (Wall Material includes in windows)

B) Net Wall Area (Wall Area-Window Area)

A. Gross Wall Area

Q=U*A*ΔT

Where,
U=Overall Heat transfer Coefficient
U=1/sumR (R=Resistance of material)
A (Area)= 25*50=1050 sq ft
ΔT=Temp difference

ΔT=106-76=30 ˚ F

B. Net Wall Area

Q= U*A* ΔT

A = 500 sq ft

ΔT= 30 ˚ F

U= O/A+1/2*(C.P)+ 8 Inch brick + ½ *(C.P)+ Internal Area

ISHRAE Standard Values

sumR=0.25 + ½ * (0.12) + 8* (0.2) + ½ * (0.12) + 0.25

sumR=2.2

U=1/sumR =1/2.2=0.45 BTU/hr ˚ F ft

Q=UA ΔT

Q=0.45*341*30

Q=4603 BTU/hr (1w=3.41BTU/hr)

Q=1.3 kw

C. Roof Area

Q=U*A*ΔT

U=1/sumR

sumR=O/A + 1 * (C.P) + 8 Inch concreate + ½ (C.P) + I/A

sumR=0.25+0.12+8*(0.08) + ½ * 0.12 + 0.65

sumR=1.72

Standards Values Of ISHRAE

U=1/1.72=0.58 BTU/hr ˚ F ft

A=30*35=806 sq ft

ΔT=106-76 =30 ˚ F

Q=U*A*ΔT

Q=0.58*806*30

Q=14024 BTU/hr

Q=4.1 kw (1w=3.41BTU/hr)

D. Internal Heat Load

1. People heat load
2. Lighting heat load
3. Electrical heat load

1. People heat load

Qs= Sensible heat / people * no of people

Ql= latent heat / people * no of people

\Ex. Class Room =806 sq ft (65 peoples)

Sensible heat (from chart of ishrae)=245

Latent heat = 155

Qs=245*65 = 15,925 BTU/hr = 4.6kw

Ql=155*65 = 10.075 BTU/hr = 2.9 kw

2. **Lighting heat load**

Q= watts / sq ft * area in sq ft * 3.4

For office = 1.1 watt/sq ft

Q=1.1 * 806 * 3.4

Q=3014.44 BTU/hr

Q=0.88 kw

Duct :- A duct is a hollow conduit or passage used to transport air, gases, or fluids from one location to another. In the context of cooling systems, a duct is an enclosed pathway that distributes cooled air from a central air conditioning unit or air cooler to various areas within a building or space.

Types of duct :-

1) Circular duct
2) Rectangular duct
3) Square duct

Different methods of duct design

1) Velocity reduction method
2) Equal friction method
3) static Regain Method

DUCT DESIGN BY EQUAL FRICTION METHOD

(Design Tools Duct Sizer Version 6.4 McQuay)

$$M° = Q/(CP \times \Delta T)$$

where,

M° = mass flow rate kg/s

Q = (kW) heat load

Cp = Specific heat capacity (kJ/kgK)

ΔT = temperature difference

Cp = 1.026 (kJ/kgK) (standard value from ISHRAE)

ΔT = should be less than 10 °C

= 14.07 kW Total Heat Transfer

M° = 2.07 kg/s

M° = kW/(kJ/kgK.8K)

Density of Air = 1.2 kg/m3

Specific volume = Density-1

= 1.2-1 = 0.833 m3/kg

Formula :-

$$\mathbf{v° = m° \times v}$$

v° = volume flow rate (m3/s)

m° = mass flow rate (kg/s)

V = specific volume (m3/kg)

V = 2.07 X 0.833

V = 1.73 m3/s (1cubic metre/second = 2118.8 cfm)

So,

v = 1.73*2118

= 3665 cfm

Required Specifications of duct and cooler

1) Cooler:-

Metal body cooler

6 Honey comb pads

1440 rpm motor

1100 watts exhaust motor

24" fan made of fiber

2 water pumps

2) Duct :-

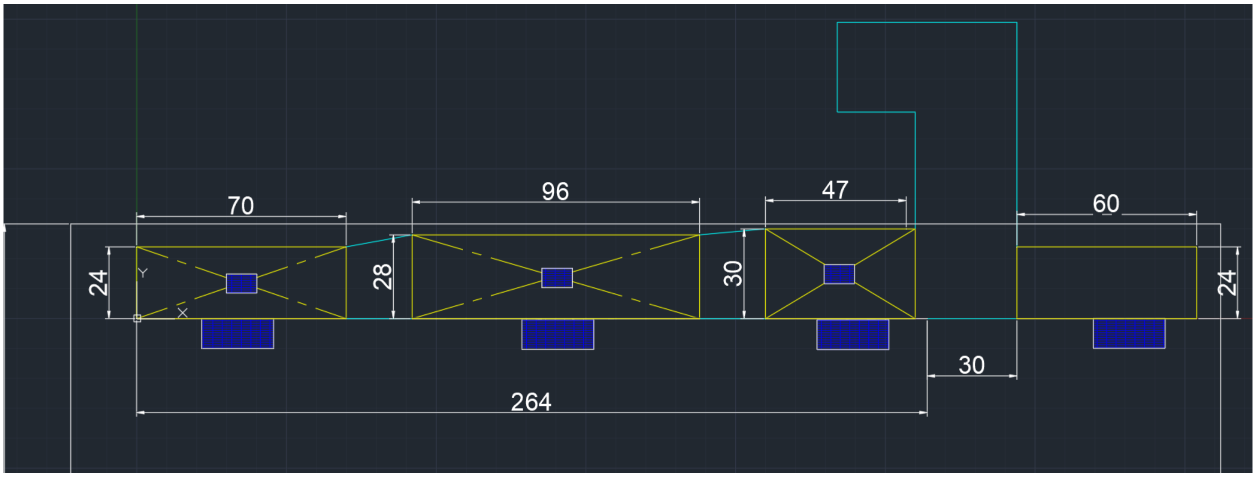
GI sheet material

Gauge:- 24

Powder coated double deflection aluminium grills

(12"*12" 3 no , 24"*10" 4 no)

Proposed CAD design:-



Actual Fabricated Model :-

Cooler **Fan**

Ducting

Conclusion :-

By taking in considering all the heat load factors while calculation of size of duct and cooler, we meet our goal to provide the necessary comfortable conditions to the students and teachers in classroom no ME-02 .The duct is capable to provide cooling effect all over the classroom .

REFERENCES:-

1) Air conditioning and Refrigeration by J.K. Gupta and R.S. Khurmi

2) C.P. Arora's Refrigeration and Air Conditioning

3) R.K. Rajput's Refrigeration and Air Conditioning

4) https://www.engineeringtoolbox.com