Smt. S. R. PATEL ENGINEERING COLLEGE

GUJARAT TECHNOLOGICAL UNIVERSITY

DESIGN AND DEVELOPMENT OF EARTH AIR HEAT EXCHANGER FOR SMALL CAPACITY

Group No.- 7

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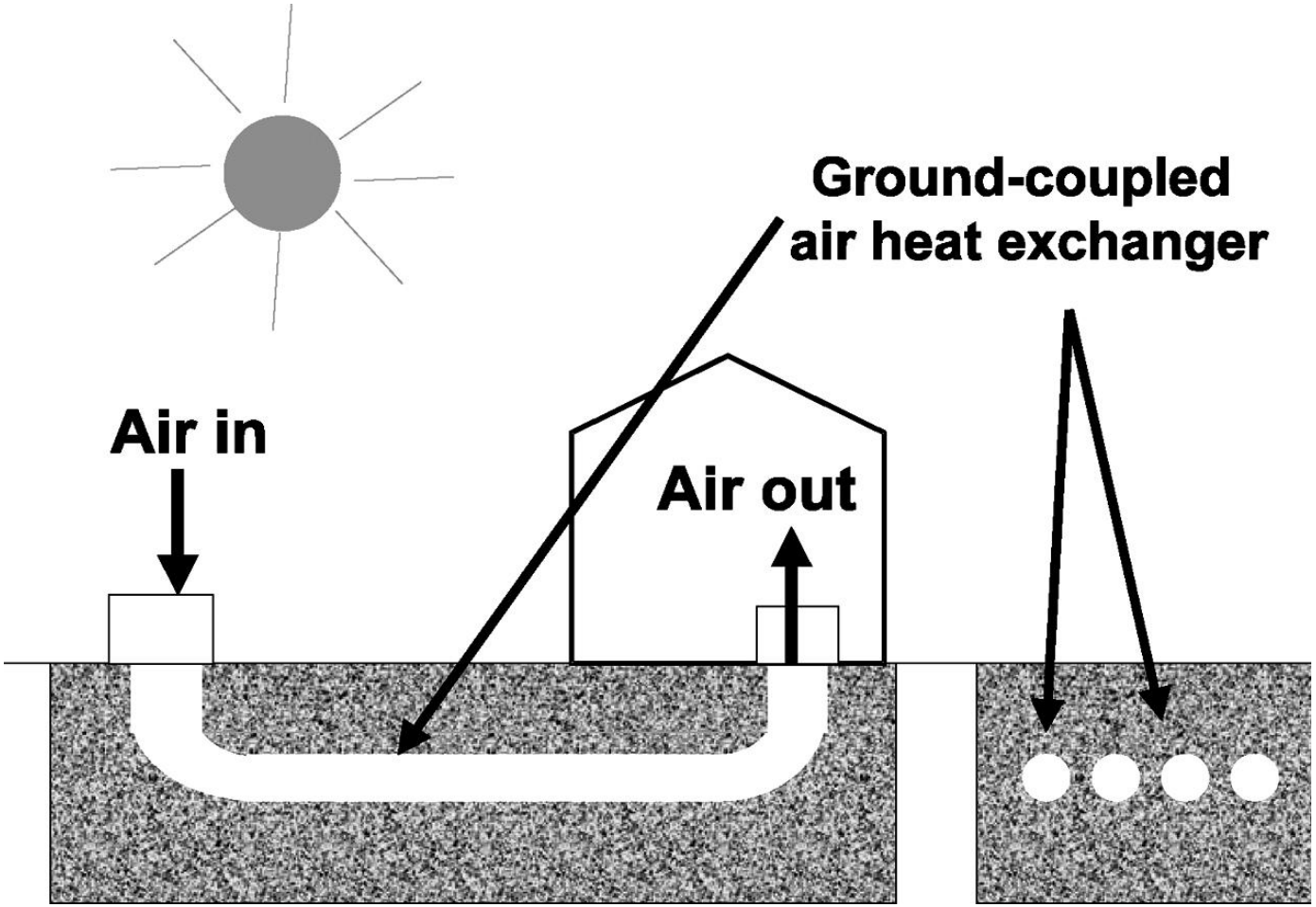
INTRODUCTION

- It is a device which is used to produce heating effect in winter.

- It is also used to produce cooling effect in summer.

HOW IT WORKS?



HOW IT WORKS?

- As we know the soil at some depth from ground surface has two properties:

1. It remains cold during summer

2. It remains hot during winter

HOW IT WORKS?

- Pipe is placed (open at both ends) inside the soil at the depth of 1m.
- Now From one side of pipe, the air flows with the help of blower and another end is fitted inside the building.
- Due to heating or cooling of the pipe the air inside the pipe also cool or heated.
- So, this air is utilized for heating or cooling purpose.

PROJECT BACKGROUND

- Till date many research has been carried out based on:

1. Length of pipe
2. Material of pipe
3. Depth from earth surface
4. Velocity of air

LITERATURE REVIEW

1. **Girja sharan,T.madhavan (2009) IIM Ahmedabad [11]**

   Length -20m

   Depth-3m

   Velocity- 3.5 m/s

   Dia. – 50mm

CONCLUSION

He conclude that temperature difference up to 6^0c in summer at 3m depth.

LITERATURE REVIEW

2. Thomas Woodson (Canada 2009) [**13**]

Length -25m

Depth-1.5m

Velocity- 2.5 m/s

Dia. – 35mm

CONCLUSION

He conclude that temperature difference up to 7.6^0c in summer at 1.5m depth.

LITERATURE REVIEW

3. M. De Paepe (Belgium 2002) [10]

Length -17m

Depth-1.25m

Velocity- 3.0 m/s

Dia. – 60mm

CONCLUSION

He conclude that temperature difference up to 6.2^0c in winter at 1.25m depth.

LITERATURE REVIEW

4. M. K. Ghosal, G. N. Tiwari (IIT DELHI 2003) [5]

Length -39m

Depth-1 m

Velocity- 2.3 m/s

Dia. – 65mm

CONCLUSION

He conclude that temperature difference up to 7^0c in summer at 1m depth.

LITERATURE REVIEW

5. Vikas Bansal, Rohit Mishra (IIT Jaipur 2009) [3]

Length -23.42m

Depth-1.4 m

Velocity- 2-5 m/s

Dia. - 80mm

CONCLUSION

He found that temperature difference up to 7^0c in summer at 1.4m depth.

OBJECTIVES

- We working on following factors:

1. Arrangement of pipe
2. EAHE with shade
3. Evaporating cooling

SCOPE OF PROJECT

- Small Scale industry
- Office cabin
- Homes
- Restaurent

TEMPERATURE OF SOIL

Fig:- Behind Prof. AGB's Cabin

Fig:- Temperature Indicator

COOLING LOAD CALCULATION

- Inner diameter of pipe (Di) = 0.022m
- Outer diameter of pipe (Do) =0.024m
- Inlet temperature of Earth (Ti) = 31^{o}c
- Surface temperature of Earth (To) =39^{o}c
- Volume (A) =38.82m^{2}
- Velocity of air (V) = 16.33 m/s
- ΔT =8^{o}c
- Average temperature =35^{o}c
- Pradult No. =0.7
- Length of pipe (l) = 9.04m
- Thermal conductivity of aluminum = 205W/m-k
- Thermal conductivity of air =0.027155W/m-k
- Kinematic viscosity =0.00001634
- $\prod$ =3.14

COOLING LOAD CALCULATION

Equation and Answers[16]

- Area of pipe
  A= ∏*Di*l
  A=0.62172m²

- Reynolds No.
  Re=(V*Di)/v
  Re=8994432

- Nussalt No.
  Nu=0.023*(Re⁴⁄₅)*(Pr)∧0.3
  Nu=74781

- Nussalt No.
  Nu=hl/k
  h=Nu*k/(l)
  h=225.63

- Overall heat transfer coefficient
  Q=1/ ((ln (r2/r1))/(2*∏*K*l))+((1)/(h*Ai))
  Q=15.671

project.xlsx

PRESSURE LOSSES CALCULATION

- **Given Data**

Q_t =7.3875*10^-3

Q=Q2=Q3=2.4625*10^-3

(1) Friction losses

H_f =25446.3 pa

(2) Sudden enlargement

h_e=60.70 pa

(3) Elbow losses

$h_l(1)$=1.14 pa

$h_l(2)$=1.14 pa

(4) Sudden contraction

$h_{c(1)}$=1.18 pa

$h_{c(2)}$=1.18 pa

$h_{c(3)}$=1.18 pa

PRESSURE LOSSES CALCULATION

(5)Sudden enlargement

$h_{e1}=h_{e2}=h_{e3}=11.5641$ pa

(6) Elbow losses

$h_{e1}=h_{e2}=11.31$ pa

(7) Sudden contraction

$h_c=10.53$ pa

(8) Total losses

1. Air intake = 20 pa
2. Air washer = 50 pa
3. Air filter = 70 pa
4. Outlet =20 pa
5. Other = 25 pa

(9) Total loss of pressure=25765.6623 pa

(10) Pressure available at outlet=79483.33 pa

Final velocity of outlet=6.06 m/s

PART LIST

- **Pipes**

Fig:- Aluminum pipe having 23mm diameter and 1mm thickness

PART LIST

- **BLOWER**

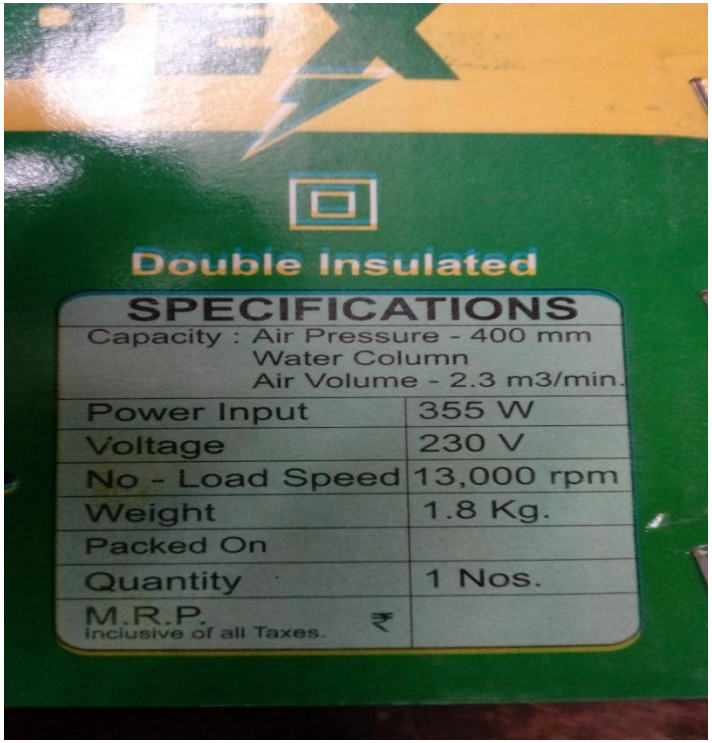


Fig:- Blower with Specification

PART LIST

- **COOLER**

Fig:-Cooler

PART LIST

- **VALVE**

Fig:- Setup of temp. measuring device

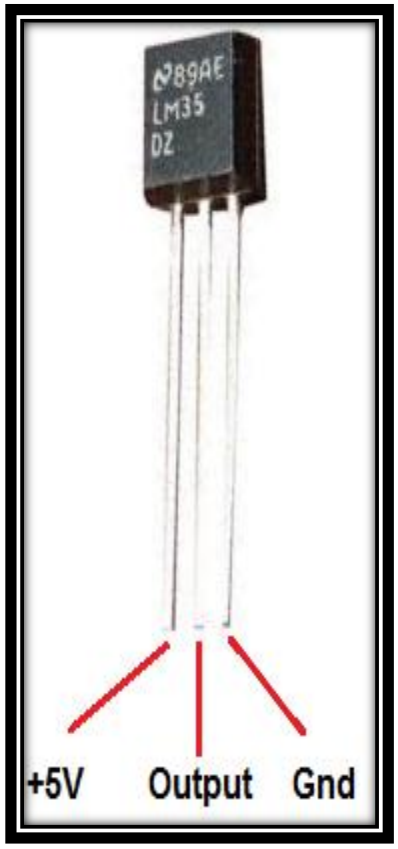
PART LIST

ANEMOMETER

Fig:- Anemometer

PART LIST

- **LM35 TEMPERATURE SENSOR**
- **Features**
- Calibrated Directly in Celsius (Centigrade)
- 0.5°C Ensured Accuracy (at 25°C)
- Rated for Full –55°C to 150°C Range
- Suitable for sensing Applications



PART LIST

- **ARDUINO MEGA CONTROLLER R3**

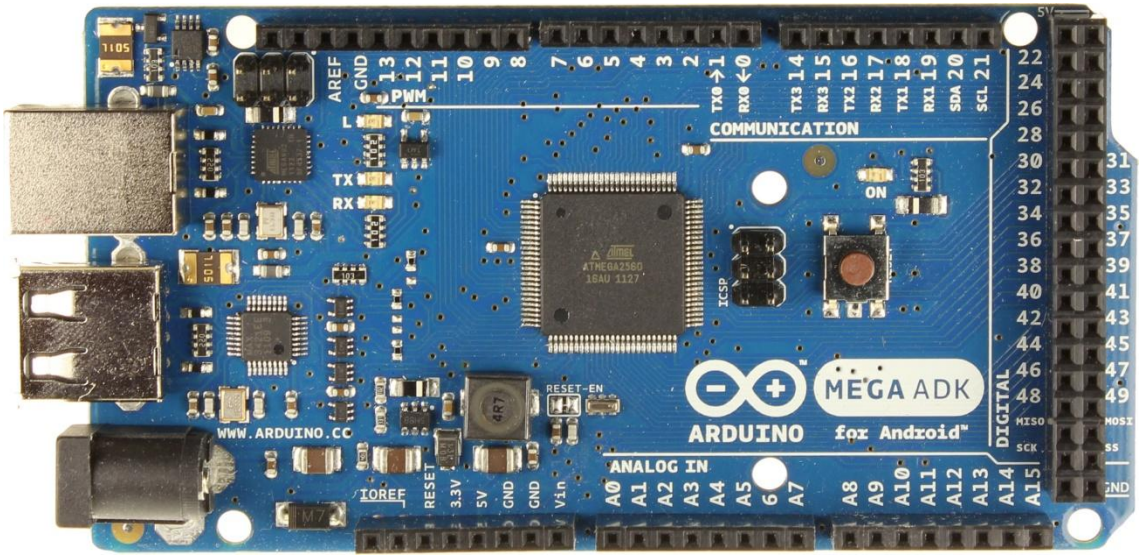


Fig:- Arduino mega controller R3

SETUP OF EARTH AIR HEAT EXCHANGER

METHODOLOGY

WORK PLAN

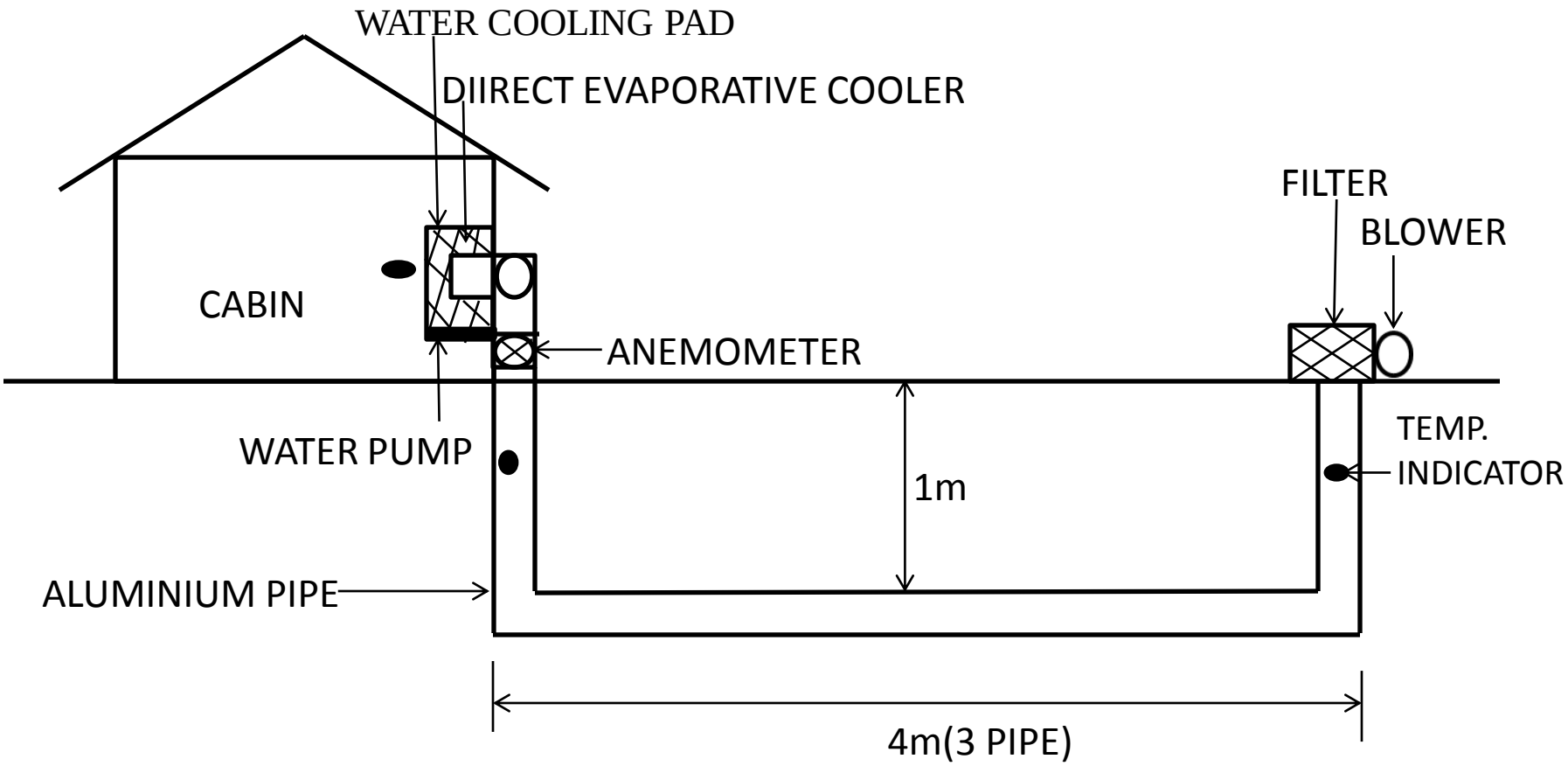


Fig- work plan

OBSERVATION TABLE

SR. NO.	TIME	ATMOSPHERE(^{O}C)	INLET(^{O}C) (BLOWER)	OUTLET(^{O}C) (COOLER)
1.	8:30A	30	40	28.2
2.	9:00A	31	42	28.6
3.	9:30A	33	45	28.7
4.	10:00A	33	45	28.6
5.	10:30A	35	46	29
6.	11:00A	35	48	29.3
7.	11:30A	37	48	30
8.	12:00P	39	55	31.5
9.	12:30P	41	56	31
10.	1:00P	42	56.2	30.2
11.	1:30P	42	52	30.30
12.	2:00P	43	50	30.15
13.	2:30P	42	48.9	30
14.	3:00P	40	49	29.5
15.	3:30P	38.6	46.3	29.5
16.	4:00P	38.3	44.8	29.6
17.	4:30P	36.5	41.6	29
18.	5:00P	34.7	41	28.7
19.	5:30P	32.4	40.25	28.2
20.	6:00P	30.6	40	28.2
21.	6:30P	30.2	37.8	28

CONCLUSION

- We have read so many research papers, books, patents on earth air heat exchanger.
- Based on that we check temperature of soil at different depth. We check the temperature of soil at 0.2m, 0.4m, 0.6m, 0.8m, 1m, 2m, and 2.5m.
- From this depths we have found that temperature of soil at 1m is 31^0c when atm. Temp. is 39^0c. 31^0c is the lowest temperature of soil from all the depths.
- So, we calculate cooling load required for cooling and identified the length of heat exchanger which is 12m and we choose aluminum for material of pipe because aluminum has good thermal conductivity, cheaper, easily available and easily fabricated.

CONCLUSION

- After designing the earth air heat exchanger based on various parameter and losses we put the setup at depth of 1 meter.
- By this we get temperature difference up to 9^0c from atmosphere at outlet of earth air heat exchanger.
- We conclude that if we pass the atmospheric air (which is at 35^0c) then we get air at 26^0c at outlet of earth air heat exchanger.

WORK PLAN FOR PROJECT

	July	Aug.	Sep.	Oct.	Nov.	Jan.	Feb.	March	April
1) Definition									
2)Research paper and check soil temp.									
3) List of required equipment and Design of eahe									
4)Experimental setup									
5) Collection of Readings									
6) Analysis of reading									

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THANK YOU FOR LISTENING!!!