Experimentation and Analysis of Evaporative Cooler for Providing Comfort Conditions in Institution Seminar Hall.

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ABSTRACT

In Vidarbha (Maharashtra, India) due to hot dry climates region desert cooler works efficiently. As the scientists [Institute of Tropical metrology at Pune] on the monsoon of different places claimed that heat waves occurrence of El Nino which occurs in the Pacific Coast of South America and adversely affect the Indian monsoon. The main reason for rising the temperature is primarily because the concentration of the Carbon Di oxide is increased by 40% since industrial times Concepts and fundamentals on heat load calculations on various object by which we can determine d the total amount of heat decapitate from the seminar hall by which the required evaporative cooler can maintain the required conditions in the seminar hall which leads to increase the comfort provided by the evaporative cooler for each person in the hall, as it also suggest the better material required for the evaporative pads , installation of cooler , capacity of blower by the calculation of C.F.M. [cubic flow of air per minute] for the comfort and effectiveness of the cooler

Keyword: - *EL Nino, C.F.M. [Cubic flow per minute]*

1. Introduction

Nowadays a great attention is paid to the environment, energy saving and energy efficiency for direct evaporative cooling, the air to be conditioned comes in direct contact with the wetted surface, and gets cooled and humidified. Hot and dry outdoor air is first filtered and then brought in contact with the wetted surface. The cooled and humidified air is supplied to the conditioned space, where it extracts the sensible and latent heat from the conditioned space. Finally, the air is exhausted into the atmosphere via windows, doors, exhaust fans, etc. A good rule of thumb is to have 1 air change every 3 minutes in northern states, 1 air change every 2 minutes in the mid section and 1 air change every 1-2 minutes in the southern states. The formula for sizing your cooler is very simple; just multiply the length by the width by the height of the area to be cooled and divide by your air change factor. It brings the comfort by increasing the humidity in dry climates, improves the air quality, and makes the air more breathable. The most familiar example of this is cooling effect of evaporating perspiration on the human skin. In arid, hot climates body temperature is partially controlled by the rapid evaporation of perspiration from the surface of the skin the evaporation rate is raised as air movement is increased. Both of these facts can be applied to natural cooling of structures.

Energy demand worldwide for buildings cooling has increased sharply in the last few decades, which has raised concerns over depletion of energy resources and contributing to global warming. Current energy demand estimates stands at between 40 and 50% of total primary power consumption. In hot climate countries, the highest share of building energy use is mainly due to space air conditioning using traditional HVAC systems. This rate of evaporation of water purely depends on the temperature humidity of the air as well as the pressure of the particular place. Hence, sweat accumulates more on hot humid days in which the perspiration is impossible to evaporate.

1.1. Specifications of Evaporative cooler

Sr.No.	ITEMS
01.	Ducting – 55 feet approximately @800/feet Made up of 0.60mm galvanized sheet
02.	Industrial by Hilton material 6mm thick On the outer side of ducts @ 200/feet
03.	Alluminium grille – 5 No. @ 1500 each Size 8”×30”
04.	**Evaporative cooler** 24” ex. Fan from Crompton greaves make 2 No. sub cooler pumps & one stand by pump G,I. sheet body Cellulose pads Auto water level float valve
05.	M.S. stand – 3” height

A research is carried out in March 2017, to study the effect of evaporative cooler on institution seminar hall.

OBSERVATIONS: - Seminar Hall

TABLE 1 **DATE (18.03.17)**

SR. NO.	Time	Indoor		Outdoor		Velocity (m/sec)
		DBT	WBT	DBT	WBT	
1.	12:00 Pm	31	29	38	26	0.7
2.	12:30 Pm	30	28	39	27	1.4
3.	1:00 Pm	31	27	38	26	1.1
4.	1:30 Pm	30	25	37	29	0.9
5.	2:00 Pm	27	26	38	26	1.5
6.	2:30 Pm	26	24	35	25	1.1
7.	3:00 Pm	27	24	36	26	1
8	3:30 Pm	28	23	35	27	1.1
9	4:00 Pm	29	27	35	26	0.6

TABLE 2 **DATE (19.03.17)**

SR. NO.	Time	Indoor		Outdoor		Velocity (m/sec)
		DBT	WBT	DBT	WBT	
1	12:00 Pm	30	29	38	26	0.7
2	12:30 Pm	29	28	39	27.5	1.4
3	1:00 Pm	28	26	38	27	1.1
4	1:30 Pm	31	27	37	29	0.9
5	2:00 Pm	29	28	36	29	1.5
6	2:30 Pm	30	27	37	26	1.1
7	3:00 Pm	28	24	37	26	1
8	3:30 Pm	29	25	36	26	1.1
9	4:00 Pm	29	24	35	28	0.6

TABLE 3 **DATE (20.03.17)**

SR. NO.	Time	Indoor		Outdoor		Velocity (m/sec)
		DBT	WBT	DBT	WBT	
1	12:00 Pm	31	30	39	27	0.7
2	12:30 Pm	30	29	38	26	1.1
3	1:00 Pm	29	28	38	26	1.4
4	1:30 Pm	28	28	37	25	1.0
5	2:00 Pm	30	25	38	24	1.7
6	2:30 Pm	28	25	36	25	1.4
7	3:00 Pm	27	26	35	24	1
8	3:30 Pm	27	24	36	23	1.3
9	4:00 Pm	28	24	35	23	0.9

TABLE 4 **DATE (21.03.17)**

SR. NO.	Time	Indoor		Outdoor		Velocity (m/sec)
		DBT	WBT	DBT	WBT	
1	12:00 Pm	31	30	38	26	0.7
2	12:30 Pm	30	29	39	27	1.1
3	1:00 Pm	29	29	38	28	1.6
4	1:30 Pm	30	28	37	27	0.8
5	2:00 Pm	29	27	37	30	1.3
6	2:30 Pm	27	29	38	27	1.2
7	3:00 Pm	28	27	36	27	1
8	3:30 Pm	29	26	37	27	1.5
9	4:00 Pm	31	25	36	28	0.7

TABLE 5 **DATE (22.03.17)**

SR. NO.	Time	Indoor		Outdoor		Velocity (m/sec)
		DBT	WBT	DBT	WBT	
1	12:00 Pm	32	29	38	26	0.7
2	12:30 Pm	31	28	37	28	1.2
3	1:00 Pm	30	28	38	27	1.3
4	1:30 Pm	31	26	37	27	1
5	2:00 Pm	29	27	37	26	1.3
6	2:30 Pm	28	26.5	37	25	1.2
7	3:00 Pm	28	27	36	26	1.1
8	3:30 Pm	29	24	37	25	1.3
9	4:00 Pm	30	23	36	26	0.7

3.1 Observation table (considering table no. 01) Area {130 m²}

1. Solar gain by glass

SR NO.	Item	Area (sq. ft)	Temperature Difference (F)	U- Factor	Heat (BTU/hr)
1	Glass W	50.21	48.2	0.56	1355
2	Glass N	50.21	43.6	0.56	1226
3	Glass S	00	82.4	0.56	00
4	Glass E	00	80.6	0.56	00
5	Glass NW	00	42.8	0.56	00
6	Glass SW	00	42.8	0.56	00
7	Glass NE	00	39.2	0.56	00
8	Glass SE	00	84.2	0.56	00

2. Solar heat gain by and transmission heat gain by walls and roofs

SR NO.	Item	Area	Temperature Difference (F)	U- Factor	Heat
1	Wall W	445.53	40.46	0.110	1983

2	Wall E	00	35.42	0.110	00
3	Wall N	389.85	39.38	0.110	1689
4	Wall S	00	37.43	0.110	00

3**. Total heat gain from (1+2) solar heat gain by glass and transmission heat gain by walls and roofs**

Sr. No.	**Item**	**Area**	**Temperature Difference (F)**	**U-Factor**	**Heat**
1	All Glass	100.420	45.9	1.1	5070
2	Wall	835.38	38.17	0.106	3380
4	Ceiling	323.47	33.8	0.40	4373.31
5	Floor	323.37	33.2	0.40	4321
				Safety Factors 5% On heads 1-5	**857.21**
				Total Heat	**18001.52**

4. **Internal Heat (Sensible Heat)**

Sr.No.	**Item**	**Quantity**	**Heat/Person Or Quantity/BTU**	**Total BTU/Hr**
1	People	75	260	19500
2	Lights	8	116.008	928.064
3	Ceiling Fan	8	255.9	2047.2
4	Desktop Computer	1	1535.4	1535.4
5	Laptop	1	341.2	341.2
6	Projector	1	1023.6	1023.6
			Safety Factors 5%	**1268.77**
			Total (SH)	**27913**

5. Internal Heat (latent heat)

Sr.No.	**Item**	**Quantity**	**Heat/Person Or Quantity/BTU**	**Total BTU/Hr**
1	People	75	205	15375
			Safety factor 5%	**768.75**
			Total (LH)	**16143.75**

6. Effective room Sensible heat =18001.52+27913 = 45914.52 BTU/hr
7. Effective room Latent heat = 16143.75 BTU/hr
8. Effective room Total heat = 45914.52+16143.75=62058.27 BTU/hr

Sr. No.	**Heat**	**BTU/Hr**	**Watt**	**Kw**
1	ERSH	45914.52	13457.52	13.45
2	ERLH	16143.75	4145.53	4.14
3	ERTH	62058.27	18189.27	18.18

- Summer Condition

Sr. No.	Conditions	DBT		WBT		% RH
		°F	°C	°F	°C	
1	Outside	100.4	38	86	30	55.9
2	Inside	84.2	29	78.8	26	78.9

From psychometric chart

h_1 = 117.02 KJ/Kg (Initial) Outside
h_2 = 98.36 KJ/Kg (Final) Inside

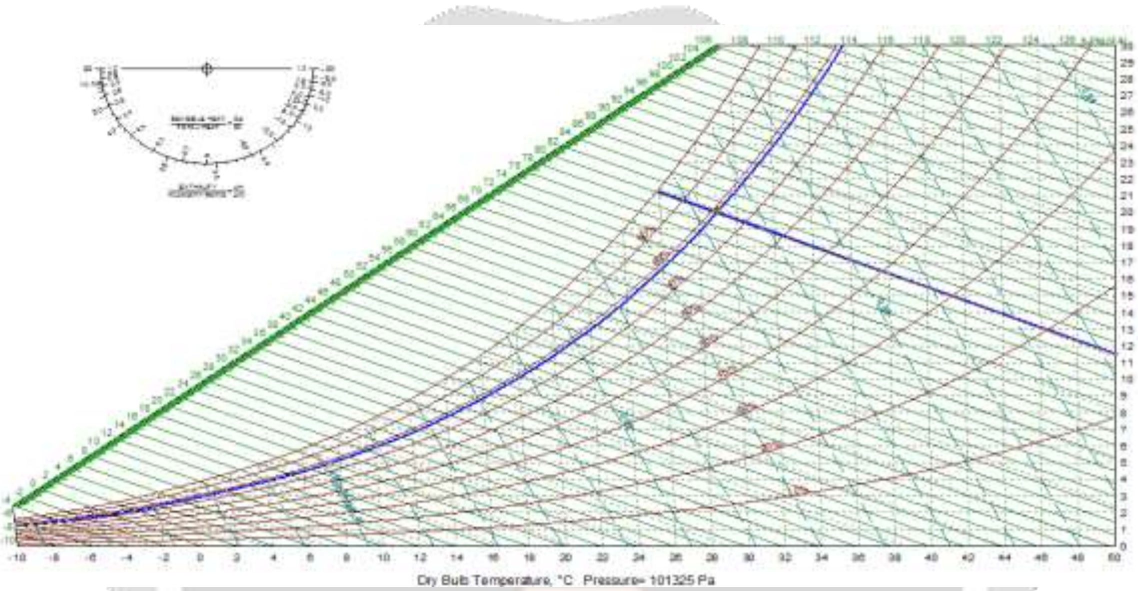

Fig:- Psychometric chart for Inside the Seminar hall Temperatures

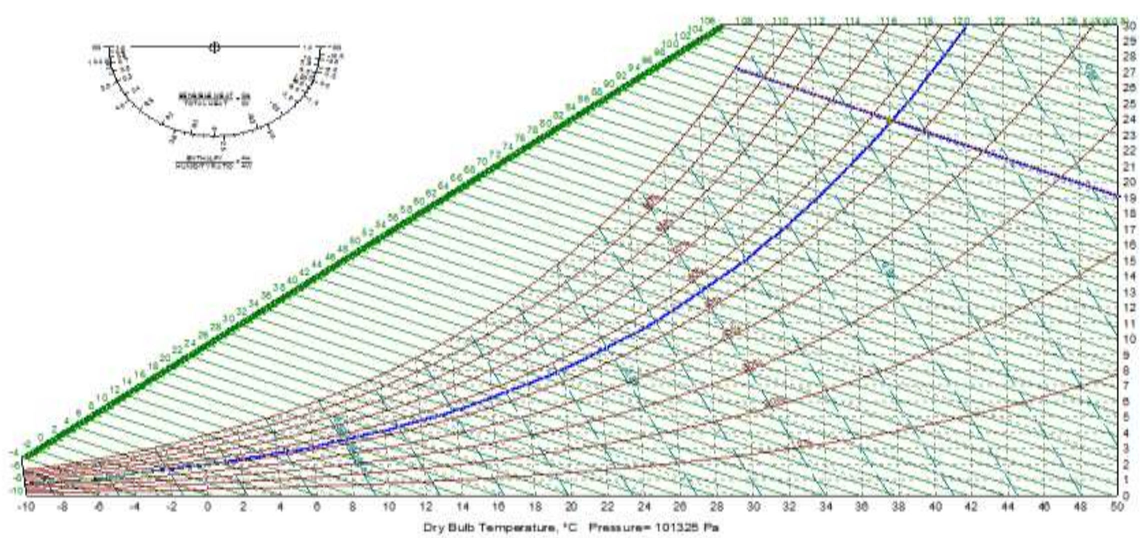

Fig:- Psychometric Chart for Outside the Seminar hall Temperatures

Now,

Sensible Heat Rate (SHR)

SHR= SH ÷ (SH+LH)

= 45914.52 ÷ (45914.52+16143.7)

= 0.739

From above, we conclude that

73.9 % sensible heat & 26.01 % latent heat

Once, we get the total sensible heat load,

We can get the supply air volume

Qs = m.Cp.ΔT ; Qs = 13.45

m = Qs ÷ Cp.ΔT ; Cp = 1.005 KJ/Kg

= 13.42 ÷(1.005×4) $\Delta T = T_2 - T_1$ T_2 = Room temperature

= 30 - 26 T_1= supply temperature from wall

= 4

m = 3.34 kg/sec

from supply condition's of coil ; we can calculate specific volume of supply sir

Vs = 0.885 m³/kg for 26°C (from Psychometric graph)

V = m × Vs

= 3.34 × 0.885

= 2.958 m³/sec

For 2.958 m³/sec

CFM = 6267.64 Ft³/min

4. CONCLUSIONS

As from the above Heat Load Calculations we have found that, the C.F.M. of our Evaporative Cooler used in Seminar Hall is 6267.64 Ft³/min. The Evaporative Cooler used in Seminar Hall is an Axial flow fan which having a characteristics of low pressure high volume. It can be used for cooling purpose but, cannot be efficient for the large rooms also the evaporative cooler installed in seminar hall having a high budget for purchasing and installing (Approx. 1.5Lakh). Now instead of this we can used Double Inlet Centrifugal Fan, it is extensively used to control air pollution system and Dust fume extraction system by that it leads to increase our comfort factor . It is efficient about 89%, they also create high pressure. As all of their moving parts are enclosed and they also have particular reduction properties that makes them ideal for use in filtration system.

6. REFERENCES

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