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Design of HVAC System for Ocean Technology Engineering and Research Centre by using District Cooling

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Abstract: The field of Heating Ventilation and Air Conditioning design of a centralized air conditioning system for any building is more technologically challenging than any other time in recent memory. While design innovations and product enhancements guarantee sleeker, more versatile, all the more intense and more energy– proficient air conditioners, the challenge today lies in recognizing the most appropriate product, or blend of products, for the application at hand.

This undertaking is carried out on an Air Cooled Chiller cycle which is way-more productive than different cycles as far as viability, maintenance and cost. It utilizes air to chill off the condenser loops not water as on account of Water Cooled Chillers, as the running expense gets increased and water may not be adequate. The aim of this undertaking is to design heating ventilation and air conditioning (HVAC) system for an approximate 40000sft area University building, simultaneously control in temperature, mugginess, appropriate air dispersion, controlled clamor level, Thermal solace, and vitality proficient and cost efficient. The venture incorporates cooling load calculations, fresh air, ventilation, exhaust design, duct design, pipe design, layout of accessories, for example, indoor and open air units and vitality effectiveness obtained on the task wherever necessary.

I. INTRODUCTION

A. *Types Of Refrigeration Systems*

1) *Vapour Compression System:* A schematic stream outline demonstrating the essential segments of vapor pack refrigeration system is appeared in figure underneath some common temperatures for aerating and cooling applications are shown. Refrigerant liquid flows through the channeling and gear to the heading appeared. There are four procedures that happen it moves through the system

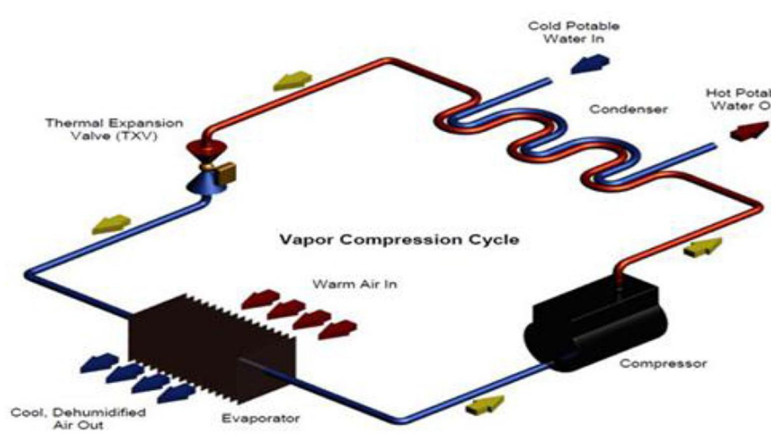

Fig.1.1(a) Vapor Compression Cycle

2) *Vapour Absorption System:* The absorption refrigeration system is very like the vapor compression refrigeration system. In the absorption refrigeration system, refrigerant is creating by dissipation of a fluid (refrigerant) in the evaporator. The distinction between the two systems lies in the strategy for changing over the refrigerant vapor back to fluid. In vapor compression system compressor and condenser are utilized to the transformation of refrigerant vapor (originating from the evaporator) into fluid. In the absorption system likewise, the condenser is utilized yet the compressor is supplanted by the mix of safeguard generator.

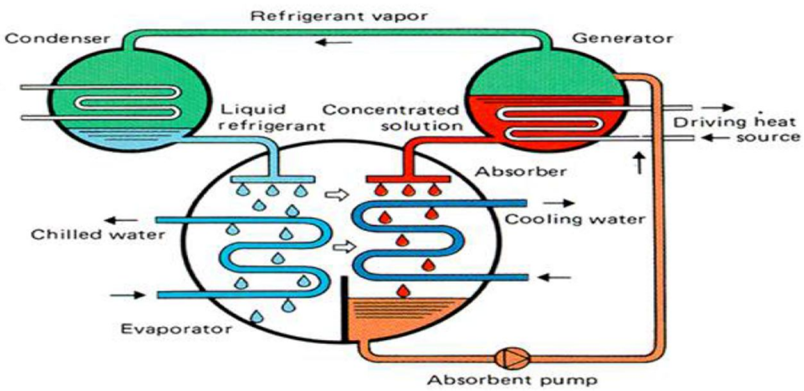

Fig.1.1 (b) Vapor Absorption Cycle

The refrigerant utilized as a part of the absorption system is one whose vapor is exceptionally dissolvable in another fluid or arrangement called permeable. The refrigerant ought to be non-unstable. The retentive compartments, one containing the refrigerant (evaporator) and the other containing the permeable (called safeguard) are interconnected.

II. LITERATURE REVIEW

A. HVAC Systems

District warming/cooling have been utilized for as far back as 200 years, first appearance was in the fourteenth century in Chaudes-AiguesCantal in France where warm water from springs was disseminated through wooden channels to family units. District Cooling is the incorporated ventilating strategy that utilizations chilled water that is exchanged through underground pipelines to structures to be utilized as a mean of cooling of the indoor air inside a specific district (certain square inside a city). The water that is utilized will be seawater. The chilly water from the primary District Cooling Unit (DCU) experiences warm exchanger inside the littler DCU to trade warm between the chilly water originating from the principle DCU and the chilly water inside the littler DCU. The water is then re-cooled for conveyance to the structures through an optional pipeline.

B. Air-Conditioning Of Multi Rooms Includes

1) *Offices:* Private workplaces include issues of zoning and individual control. General workplaces and extensive open office spaces might be dealt with as basic units yet it ought to be perceived that it isn't conceivable to fulfill each tenant of general office. This does not imply that the system ought not to be planned with legitimate limit of air conveyance. It means that the temperature, which is acceptable to lion's share of inhabitants, may neglect to please excessively few. Space utilized of gathering and chiefs rooms requires unique treatment on account of wide variety in inhabitance and the requirement for more noteworthy ventilation when tenants are smoking. It is a decent practice to give a smoke debilitates system and ought to be dealt with as isolated zones.
2) *Examples:* hospital private Rooms, Hotel Guest Rooms, Restaurants, Theaters and Auditoriums.

C. Design of HVAC systems

The essential capacity of air conditioning is to keep up conditions that are (1) Conductive to human solace or (2) Required by an item, or process inside a space. To play out this capacity gear of the best possible limit must be introduced and controlled consistently. The gear break stack prerequisites, kind of control are controlled by the conditions to be kept up amid pinnacle and halfway load. For the most part it is difficult to gauge either the real pinnacle or the halfway load on any given space, these heaps should be evaluated. It is for this reason the information contained has been arranged. Prior to the heap can be assessed, it is basic that a complete overview be made to guarantee exact assessment of the heap segments. In the event that the building offices and the genuine immediate load with a given mass of the building are painstakingly examined and sparing gear choice and system configuration can result, and smooth, inconvenience free execution is then conceivable.

D. Space Characteristics and Heat Load Sources

Orientation of building, Physical measurements of spaces, Ceiling tallness, Columns and beam, Construction materials, Surrounding Conditions, Window measured and area, Doors, Stairways, lifts and elevators, People, Lighting, wattage at crest, Type, Motors.

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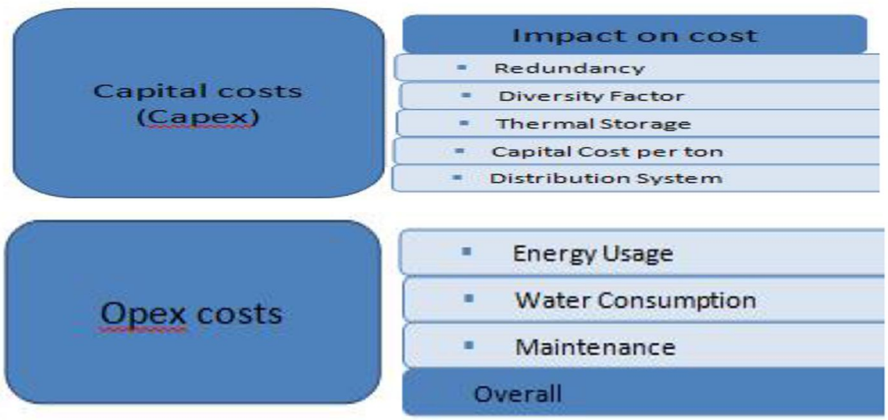
E. Design Conditions

1) *Out-Door Design Conditions-summer and winter:* The open air configuration conditions recorded in are the business acknowledged plan conditions as distributed in ARI sexually transmitted disease. 530-56 and the 1958 ASHRAE manage. The conditions as recorded allow a decision of dry-globule temperature for various kinds of utilizations as sketched out beneath.
2) *Ordinary Design Conditions-Summer:* Ordinary outline conditions are prescribed for use with comfort mechanical cooling applications where it is infrequently allowable to surpass the plan room conditions. These open air configuration conditions are the all the while happening dry-globule and wet knob is surpassed more every now and again than the wet-globule is lower than outline. When cooling and dehumidification (drying out) are performed independently with these sorts of utilizations utilize the typical outline dry-globule temperatures for choosing the sensible cooling mechanical assembly: utilize a dampness content comparing to the ordinary plan wet-knob temperature and half to select the dehumidifier (dehydrator).

F. Economics: comparison with alternative



G. Operation of District cooling

Standards of District Cooling District cooling is a system in which chilled water is circulated in funnels from a focal cooling plant to structures for space cooling and process cooling. A district Cooling system contains three noteworthy components: the cooling source, a distribution system, And client establishments, likewise alluded to as vitality exchange stations (ETS). These components are portrayed in Figure District cooling systems can be subdivided into three gatherings in view of supply temperatures:

1) Conventional chilled water temperatures1: 4o C (39o F) to 7o C (45o F)
2) Ice water systems: +1o C (34o F)
3) Ice slurry systems: - 1o C (30o F)

This report centers around the ordinary and ice water based chilled water systems, which are for the most part intended for a greatest weight of 1030 kPa (150 psig). A short broad discourse on ice slurry system innovation is additionally included. Cooling Source Chilled water is normally produced at the district cooling plant by blower driven chillers, ingestion chillers or different sources like encompassing cooling or "free cooling" from profound lakes, streams, aquifers or seas. Cooling strategies are talked about in more detail.

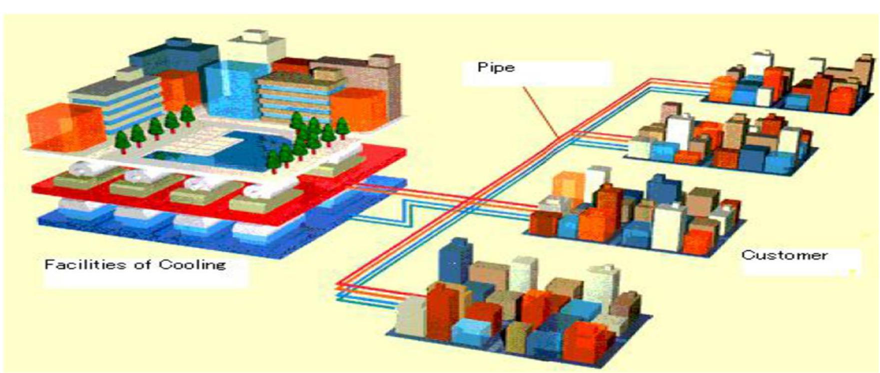


Fig.2.1: Simple District cooling System

Distribution District chilled water is conveyed from the cooling source(s) to the clients through supply pipes and is returned in the wake of removing heat from the building's optional chilled water systems. Pumps circulate the chilled water by making a weight differential (DP) between the supplies and return lines. Figure delineates the weights in a disentangled distribution system with a solitary plant design, utilizing variable speed pumps, amid winter (Figure 4.2-an) and summer conditions.

H. Distribution of Chilled water piping

The thermal limit of the district cooling system is controlled by both the rate of water stream and the temperature differential (ΔT). A huge ΔT takes into account the utilization of littler channels, which decreases the capital venture for development of the system. The system working proficiency likewise increments with an expanded ΔT because of the lessened pumping prerequisites caused by the diminished stream rates and the decreased warmth picks up/misfortunes in the distribution system. To delineate this with an illustration, Figure 2.2 demonstrates the connection amongst ΔT and pipe estimate. The case outlined in the figure demonstrates that the pipe estimate, in light of a steady weight inclination of 150 Pa/m, diminishes from 800 millimeters (32 inches) to 600 millimeters (24 inches) when the temperature differential increments from 5o C (9o F) to 11o C (20o F) for a load of 50 MW (~14,000 tons). The pinnacle pumping prerequisites (i.e. pull) would be diminished by more than half with the expanded ΔT.

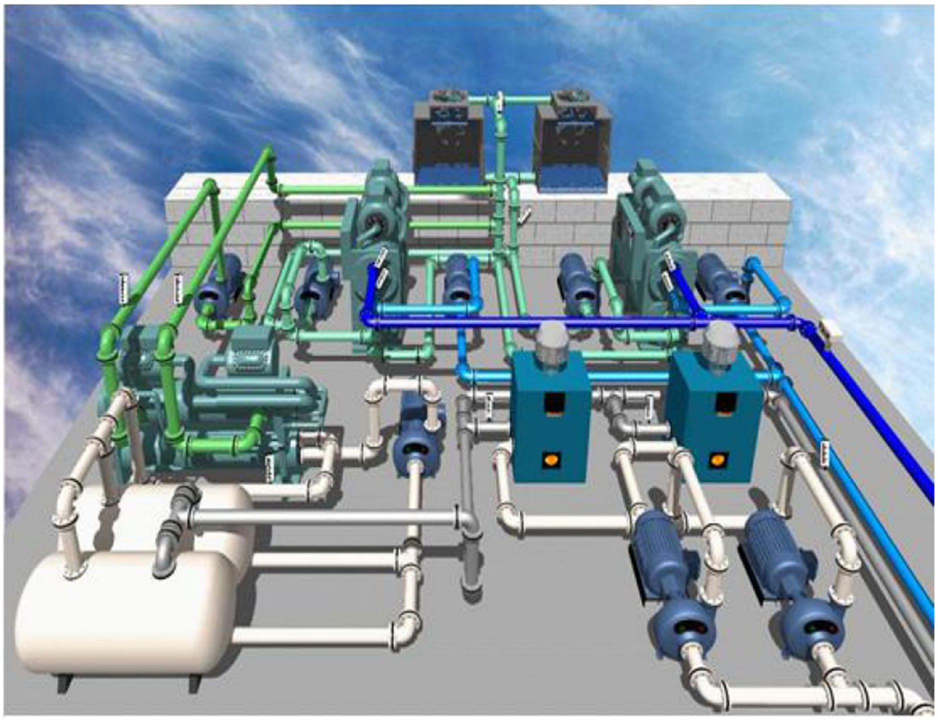


Fig.2.2: Piping Layout

III. BUILDING DESCRIPTION

A. Overview

This section is an initial phase in recognizing the points and goals in this undertaking by assessing the most recent research in design and examination of HVAC systems. The past looks into demonstrate the discoveries of thermal solace of the inhabitants in light of the indoor and outside temperatures. The examination discoveries demonstrate that there is a need to anticipate the solace levels of the inhabitants continuously because of the intricate warmth stream designs. This will be finished by speaking to the real site conditions and in light of the genuine climate information to study the impact of ecological variables influencing the solace levels checks will be made on the current natural system to indicate it is achievable to keep up the solace levels as Determined in the ASHRAE norms.

B. Ocean Technology Engineering and Research Center

The site on which the HVAC system is designed is Ocean tech Engineering & Research Building which is located at Hyderabad. Functional areas must be defined in order to develop a well-planned and efficient facility.

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C. Project Details

Total Floor Area: 60000sft, Occupancy: 2000

D. Area Wise Statement

SL.NO	AREA NAME	AREA IN SMT	AREA IN SFT
	GROUND FLOOR		
1	SCIENCE CENTER	598.00	6434
2	MULTIPURPOSE HALL	133.00	1431
3	SERVER ROOM	356.40	3835
4	RECEPTION AREA	300	3228
5	LOUNGE	40.91	440
6	REGISTRAR ROOM	48.6	523
7	ANTI ROOM	22.289	240
8	ADMIN SUPPORT	117.9	1269
9	DEAN ADMIN	82.53	888
10	BOARD ROOM 1	72	775
11	BOARD ROOM 2	72	775
12	ANTI ROOM	19.54	210
13	WAITING ROOM	29.2	314
14	DEAN OFFICE	47	506
15	LADIES ROOM	65	699
16	STUDENTS ROOM	65	699
17	TEA AND SNACK AREA	227.7	2450
18	SERVICE/PANEL ROOM	47.86	515
		2345	**25231**

SL.NO	AREA NAME	AREA IN SMT	AREA IN SFT
	FIRST FLOOR		
1	EXHIBITION HALL	598.00	6434
2	CLASS ROOM	133.05	1432
3	CLASS ROOM	133.05	1432
4	CLASS ROOM	133.05	1432
5	CLASS ROOM	245	2636
6	THEORY TYPE LECTURE HALL	296	3185
7	DEMO LAB	110	1184
8	COMPUTER LAB	110	1184
9	LOW-LVL FACULTY	14.4	155
10	LOW-LVL FACULTY	14.4	155
11	LOW-LVL FACULTY	14.4	155
12	LOW-LVL FACULTY	18.88	203
13	LOW-LVL FACULTY	18.88	203
14	LOW-LVL FACULTY	18.88	203
15	LOW-LVL FACULTY	20.16	217
16	LOW-LVL FACULTY	20.16	217
17	LOW-LVL FACULTY	20.16	217
18	LOW-LVL FACULTY	20.16	217
19	VISITING FACULTY	15.63	168
20	VISITING FACULTY	15.63	168
21	TEA AND SNACK AREA	226	2432
22	SERVICE/PANEL ROOM	14.31	154
		2210	**23782**

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IV. HVAC CALCULATIONS

A. Load Calculation

It is important to think about the heat sources and their temperament before taking the activity of plan of air-conditioning framework. The air-conditioning framework utilized needs to complete two kinds of burdens known as sensible-heat stack and latent heat stack. Sources, which add to sensible heat, are recorded underneath.

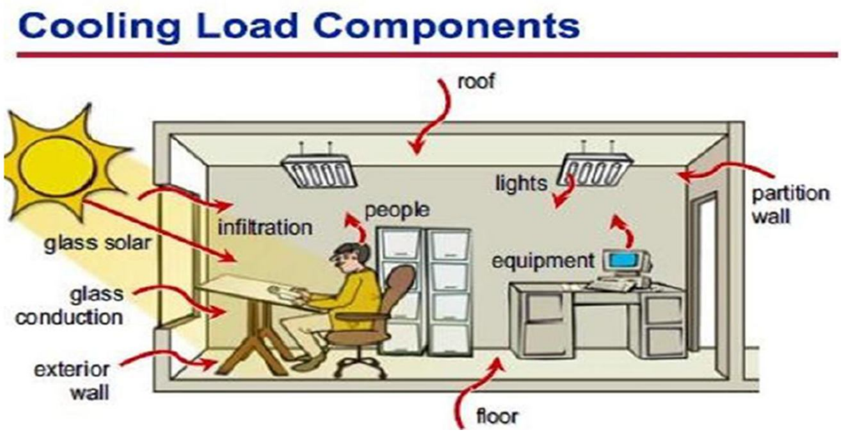


Fig. 4.1: Sources of Heat generation

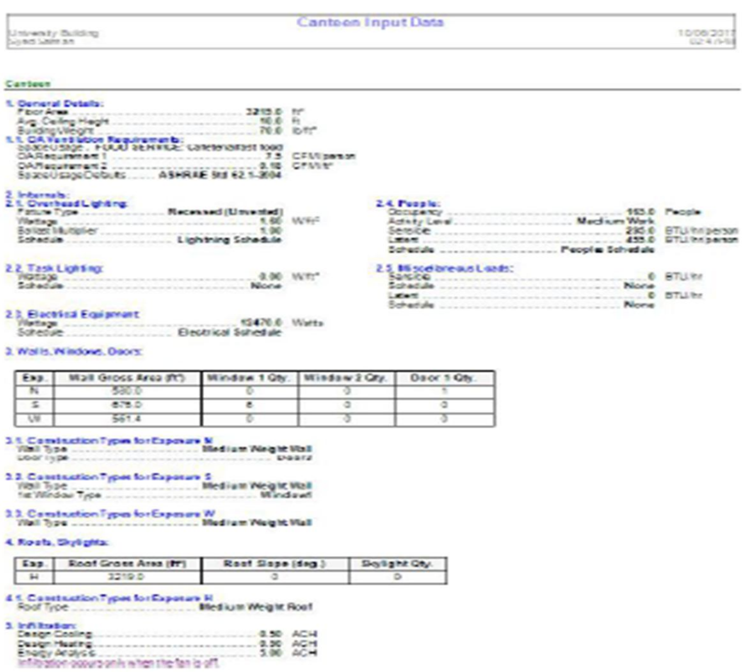
B. Heat gain through People

A standout amongst the most imperative wellsprings of inward heat is individuals. Individuals in the room emit both sensible heat and latent heat. The correct sum is dictated by the movement of
The general population and the room conditions.

C. Hourly Analysis Program (HAP)

HAP is a PC application which helps works in delineating HVAC systems for business structures. HAP is two gadgets in one. At first it is an instrument for surveying loads and sketching out systems. Second, it is an instrument for copying imperativeness use moreover, figuring essentialness costs. In this utmost it is useful for LEED®, schematic blueprint and point by point plan imperativeness cost evaluations.

Input data



Canteen Input Data

Canteen

1. General Details:
Floor Area .... 3219.0 ft²
Avg. Ceiling Height .... 10.0 ft
Building Weight .... 70.0 lb/ft²
1.1. OA Ventilation Requirements:
Space Usage .... FOOD SERVICE: Cafeteria/fast food
OA Requirement 1 .... 7.5 CFM/person
OA Requirement 2 .... 0.18 CFM/ft²
Space Usage Defaults .... ASHRAE Std 62.1-2004

2. Internals:
2.1. Overhead Lighting:
Fixture Type .... Recessed (Unvented)
Wattage .... 1.60 W/ft²
Ballast Multiplier 1.00
Schedule .... Lightning Schedule

2.2. Task Lighting:
Wattage .... 0.00 W/ft²
Schedule .... None

2.3. Electrical Equipment:
Wattage .... 13470.0 Watts
Schedule .... Electrical Schedule

2.4. People:
Occupancy .... 163.0 People
Activity Level .... Medium Work
Sensible .... 295.0 BTU/hr/person
Latent .... 455.0 BTU/hr/person
Schedule .... People Schedule

2.5. Miscellaneous Loads:
Sensible .... 0 BTU/hr
Schedule .... None
Latent .... 0 BTU/hr
Schedule .... None

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (ft²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	580.0	0	0	1
S	678.0	6	0	0
W	561.4	0	0	0

3.1. Construction Types for Exposure N
Wall Type .... Medium Weight Wall
Door Type Door2

3.2. Construction Types for Exposure S
Wall Type .... Medium Weight Wall
1st Window Type Window1

3.3. Construction Types for Exposure W
Wall Type .... Medium Weight Wall

4. Roofs, Skylights:

Exp.	Roof Gross Area (ft²)	Roof Slope (deg.)	Skylight Qty.
H	3219.0	0	0

4.1. Construction Types for Exposure H
Roof Type .... Medium Weight Roof

5. Infiltration:
Design Cooling .... 0.50 ACH
Design Heating .... 0.50 ACH
Energy Analysis .... 5.00 ACH
Infiltration occurs only when the fan is off.

Resulting data

Air System Sizing Summary for AHU1(Canteen)

Project Name: University Building — 10/05/2017
Prepared by: Syed Salman — 02:46PM

Air System Information

Air System Name	AHU1	Number of zones	1
Equipment Class	CW AHU	Floor Area	3210.0 ft²
Air System Type	SZCAV	Location	Hyderabad, India

Sizing Calculation Information
Zone and Space Sizing Method:

Zone CFM	Sum of space airflow rates	Calculation Months	Mar to Oct
Space CFM	Individual peak space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	36.1	Tons	Load occurs at	Jun 1500	
Total coil load	433.4	MBH	OA DB / WB	105.0 / 78.0	°F
Sensible coil load	295.7	MBH	Entering DB / WB	85.2 / 67.4	°F
Coil CFM at Jun 1500	9883	CFM	Leaving DB / WB	55.4 / 52.1	°F
Max block CFM	9883	CFM	Coil ADP	50.1	°F
Sum of peak zone CFM	9883	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.682		Resulting RH	58	%
ft²/Ton	89.1		Design supply temp.	50.0	°F
BTU/(hr-ft²)	134.6		Zone T-stat Check	0 of 1	OK
Water flow @ 10.0 °F rise	86.72	gpm	Max zone temperature deviation	0.1	°F

Central Heating Coil Sizing Data

Max coil load	59.9	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	9883	CFM	BTU/(hr-ft²)	18.6	
Max coil CFM	9883	CFM	Ent. DB / Lvg DB	66.7 / 72.7	°F
Water flow @ 20.0 °F drop	5.99	gpm			

Supply Fan Sizing Data

Actual max CFM	9883	CFM	Fan motor BHP	5.71	BHP
Standard CFM	9186	CFM	Fan motor kW	4.25	kW
Actual max CFM/ft²	3.05	CFM/ft²	Fan static	2.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	2371	CFM	CFM/person	13.76	CFM/person
CFM/ft²	0.74	CFM/ft²			

D. Duct Designing

The function of duct system is to transmit air from the air handling apparatus to the space to be conditioned. To fulfill this function in a practical manner, the system must be designed within the prescribed limits of available space, friction loss, velocity, sound level, heat and leakage losses and gains.

E. Aspect Ratio

The aspect ratio is the ratio of the long side to the short side of a conduit. This ratio is a critical factor to be considered in the underlying plan. Expanding the aspect ratio increment both the introduced cost and the working expense of the framework.

F. Duct Designing Methods

There are different ways methods by which the duct size can be obtained which are having advantages and disadvantages on one another

1) Equal friction method
2) Velocity reduction method
3) Static regains method

G. Duct Material

The channels are normally produced using aroused iron sheet metal, aluminum sheet metal or dark steel. The most ordinarily utilized pipe material in air conditioning frameworks is stirred sheet metal, in light of the fact that the zinc covering of the metal avoids rusting and a voids the expense of painting. The sheet thickness of stirred iron (G.I) channel shifts from 26 check (0.55mm) to 16 measure (1.6 mm).

H. Application

For cooling, a high sidewall area is favored. The air can be coordinated somewhat curves upward: it at that point will take after the roof impact, blending great the roof because of the roof impact, blending admirably with prompted auxiliary air.

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V. DISCUSSION OF RESULTS

Thermal Care R-134A Air Cooled Centrifugal Chiller					
System Loading (%)	System Cooling Load (Tons)	Operating Profile (%)	Operating Time (Hrs/Yr)	Total Unit Energy Consumption (kW/Ton)	Total Chiller Energy Cost ($/Yr)
100%	140	1%	60	0.62	$364
75%	105	42%	2,520	0.482	$8,934
50%	70	45%	2,700	0.435	$5,762

R-134A Water Cooled Rotary Screw Chiller					
System Loading (%)	System Cooling Load (Tons)	Operating Profile (%)	Operating Time (Hrs/Yr)	Total Unit Energy Consumption (kW/Ton)	Total Chiller Energy Cost ($/Yr)
100%	140	1%	60	0.614	$361
75%	105	42%	2,520	0.591	$10,940
50%	70	45%	2,700	0.619	$8,192
25%	35	12%	720	0.619	$1,092
					$20,585

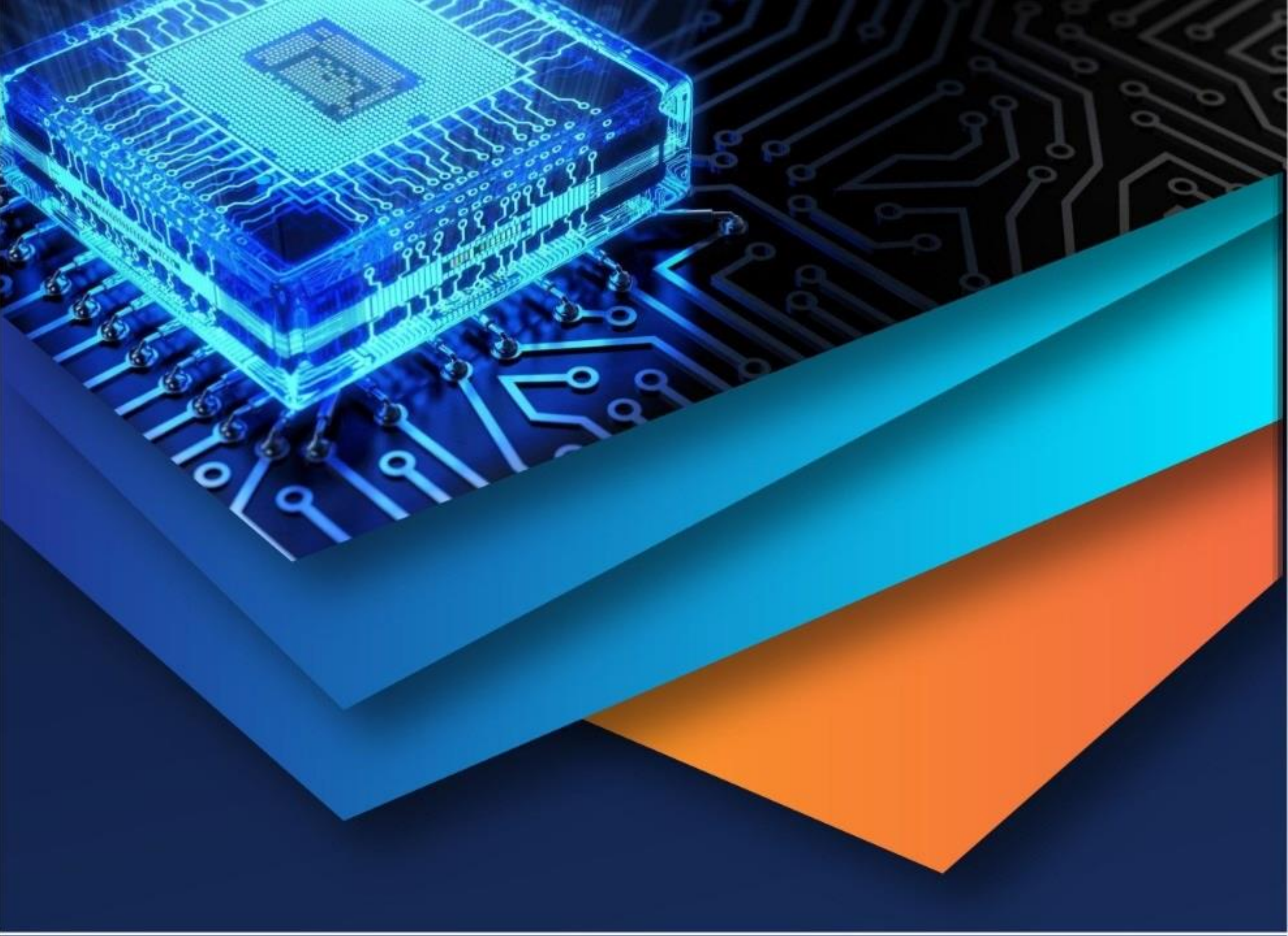
VI. CONCLUSION AND RECOMMENDATIONS

In this project design of district cooling system is done successfully for a University ,the the total
Chiller load of district cooling system obtained is 356 TR , of 168 kw. The area of this university is 49013 sft. The aim of this project is achieved by developing the DCS system. While plan advancements and thing overhauls ensure sleeker, more versatile, simply more extreme and more energy– capable ventilation frameworks, the test today lies in separating the most fitting thing, or mix of things, for the present application.

With reference to the building outline of University and essential of the case issue, ventilating load is assessed for consistent conditions. The endeavor is done as "Outline of HVAC Central Air Conditioning System for a University Building". This undertaking is completed on an Air Cooled Chiller cycle which is far more proficient than different cycles as far as adequacy, support and cost. It utilizes air to chill off the condenser loops not water as on account of Water Cooled Chillers, as the running expense gets expanded and water may not be adequate.

REFERENCES

[1] ASHRAE. 2000. ASHRAE Handbook -2000 HVAC Systems & Equipment,
[2] Chapter 44.Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
[3] ASHRAE Handbook (2007) - ‘Heating Ventilating and Air-Conditioning- Applications.
[4] Refrigeration and Air Conditioning- By: R.S Khurmi and J.K. Gupta.
[5] Modern Refrigeration and Air conditioning-By: Andrew D.Althouse.
[6] Refrigeration and Air Conditioning-By: Ahmadul Ameen
[7] Related Web Links:
[8] https://www.ashrae.org/resources--publications/bookstore/handbook-online
[9] https://en.wikipedia.org/wiki/Hvac
[10] http://www.weathercoolsystem.com
[11] https://www.scribd.com/doc47631764/Air-Conditioning-Principles--and- Systems-An- Energy-Approach-4th-Edition



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