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## Design of HVAC System for a Commercial Building by using Radiant Cooling

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Abstract: The design of air conditioning (HVAC) systems for commercial building by using radiant cooling systems. Radiant cooling system is a promising technique, which is suitable for independent control processes of temperature and humidity. The two main benefits of radiant cooling systems include the potential to save energy and improvement of indoor thermal comfort. The Radiant Cooling with Ceiling system consolidates the pipe network in each panel and the piping are connected to the chiller through these pipes the chilled water will be circulated to the ceiling panels. Ceiling panels are designed in such a way that there would be no condensation occurs at ceiling panels as they are designed below dew point temperature. The radiant cooling panels can work more The surveying data conducted during the design indicate how much of the tonnage required for the whole area with which we can distribute the temperature in the surface through radiant ceiling panels for the proper comfort of the occupants in the space. Our designing .Our calculations determine the coil size too for fixing it at the ceiling; the coil size will determine to fix it at ceiling panels. In our project there is a separate system to provide air for ventilation and for additional cooling for the occupants in the space. These establishments will be really helpful in optimizing and controlling the strategies of HVAC system. The project work includes heat load calculation of the building through hourly analysis program (HAP), duct designing through mc quay duct sizer, pipe sizing through mc quay pipe sizer, drafting of air distribution system.

#### I. INTRODUCTION

#### A. Introduction To HVAC

The term HVAC which truncates to heating, ventilation, and air condition, as it has a huge scope? It managed the system utilized for application like heating, comfort cooling, and ventilation and cooling application in commercial areas. It incorporates study of extensive variety of equipment's from little scale residential application to the huge Industrial applications. The standards or phrasing, terminology of HVAC are taken from the society called as ASHRAE which refers to American society of heating, refrigeration and air conditioning engineers. Nowadays a innovative and better air conditioning system is majorly has the objective with the advancing, human comforts. In these incredible advancements can be made however the extents of further research still subsist. Indoor air quality is a huge constraint in the outline of an aerating and cooling frameworks as it a noteworthy concern worldwide since, it enormously influence the relieve in the work space or in industrial requirements. Majorly the study of indoor air Quality and its effect are mostly concern in the field of an air conditioning The important consideration is conservation of energy resource in decreasing and optimizing the utilization of energy in recently constructed infrastructures and in existing spaces with wanted comfort conditions and indoor air superiority. As this requires a Arrangements of certain disciplinary approach which are to be implemented while designing and an aerating system.

- 1) Heating: Heating is defines as the procedure of increasing or expanding the warmth of the space Where compared to surrounding heat of the space is gradually bringing down with Standard temperature (25 °c) respectively. The heating procedure is carried through by Various methods such as equipment's like boilers, heaters, etc..., heating methods or Consideration are generally they are implemented in countries like USA, Australia, Canada etc...,
- 2) *Cooling:* Cooling is defines as the way of lessening the temperature of the air where the Surrounding temperature of that area is higher than the calm temperature by implementing The various standards of refrigeration or heat exchanges to the lower body temperature is Know as cooling.
- 3) Ventilation: Ventilation has an imperative influence in parts of HVAC outline fill in as it is show as the Procedure by which outside air is provided into the space being molded and it additionally Expels the undesired air from the space and furthermore the contaminants which are Available inside the space. The ventilation is done through constrained ventilation process Or it should be possible by characteristic ventilation process for keeping up the great air Quality with in the space.



4) Air Conditioning: Air conditionings describes as the procedure of regarding air in order to control simultaneously its temperature, humidity, cleanliness and distributing and meet the Prerequisites of conditioned space.

#### B. Introduction on Radiant Cooling

The radiant cooling system is a system using a temperature controlled surface that cools Indoor temperature by evacuation of sensible heat where the half of the warmth happens through the thermal radiation. Generally the radiant cooling systems are concerned in Chilled ceiling beams or panels. With the benefit of convection air cooling and additionally Normal radiant temperature to be attain. Radiant system that utilizes water to cooled the Desired surface are known as hydronic systems .the hrdronic radiant system flow the Cooled water in pipes through an extraordinary mounted panels on a building floor or Ceiling to supply comfortable temperature

#### C. Statement of Problem

The problem underlying of my project radiant cooling system to examine the indoor temperature and the thermal comfort in a surface where a cooling will be done by radiant cooling with the ceiling panel. An important study in my plan is to look into thermal comfort for people working in the office space, equipment to be cooled. The stature of the floor influences the thermal comfort in the specified area. If the floor height modifies there will be a change in the ratio of convection and radiation. Mean radiant temperature (MRT) calculations are done very complicated because it requires the variation between the incoming air temperature and the incoming water temperature and also requires the leaving air temperature from the room and the leaving water temperature from the room. For cooling, it is critical to maintain the temperature of the external surface of the tubing that carries cooling water lower than dew point temperature to avoid condensation.

#### D. Research Methodology

In research methodology, for computing the heat load there is standard software HAP (hourly analysis program) which will give the complete report to find cooling conditions capacity to accomplish good indoor air quality as it is a powerful tool. HAP gives adaptable features for outlining hvac system for commercial buildings. As it also offer energy analysis and energy utilization. Another tool used is duct sizer which is utilized for calculating duct sizes and the area and pipe sizer is utilized to cal calculate the pipe size for the flow of water through it. ASHRAE standards are available to take the values and expressions to find the coil size which we utilized in ceiling panels.

#### II. HVAC SYSTEM

#### A. Radiant Cooling From Chilled Slabs

Cooling originates from the structure of the building like slabs, in view of this it is named as thermally active building system (TABS). Transfer of cooling in this kind of Radiant cooling system with integrated slabs to the area as of the floor or ceiling. Europe since last couple of tens the heating is as same as floor cooling respectively. The radiant air conditioning which is available in terms of chilled slabs or ceiling panels, to attain the benefit of convective conditioning and the mean radiant temperature .because of cool air sinks, a chilled ceiling panel wills cold the air that will make itself to spread into the space through specialized panels. There are so many advantages to deliver the cooling with ceiling. It is more agreeable to leave roofs presented to a room than floors, as it will increase the capability of thermal mass. Floors have furniture, covers, and decorations that decline the feasibility of the association. At the point when guideline of a cooling talks in Radiant cooling system it utilizes the regular purpose of rule to convey the cooling to ceiling or through the floor or even with the walls since it ingests the warmth emanated through the rest of the way. The following diagram is clearly showing us the chilled ceiling

15 behaves as temperature go down for every origin throughout the space which includes likewise people present in the room, solar radiation, the equipment loads and the wall etc.



Figure 2.1- radiant cooling from ceiling



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The radiant cooling system which normally utilizes chilled water, as it is a hydronic system which uses water running in the pipes channel in thermal contact with the airfoil. The circling water just should be 2-4°C underneath the coveted indoor air temperature. The high temperature is expelled by the water falling in the pressure driven circuit once the heat from various starting points within the zone is engaged by the effectively cooled surface –ceiling which is on the roof, base or walls.

#### B. Design of HVAC System

1) Basic On Radiant Cooling System Utilizing Bore Wells: To keep up slab temperature and soil temperature equal with an association comprises of two bore wells from which one is associated with radiant slab and water is pumped through it and another drag well is linked with the heated water that leaves the radiant slab. During the time the temperature of earth beneath 12ft is consistent which is a mean temperature of particular geographical limitation is. The underneath figure demonstrates recorded room temperature. Utilizing stack impact ventilation framework, the way is likewise ventilated.



Figure 2.2-Radiant cooling system utilizing bore well

Firstly we should have to see the geological ground conditions at the site .from these surveys we can get the ground parameters required by this we can send the water from the bottom to the ceiling panels by which a greater savings be able to be accomplished as the water is a natural resource.

2) Radiant Cooling Systems Utilizing Cooled Water: In this plan, the chiller creates the cool water by which the slab is chilled. The dew point temperature of breeze is progressively more when contrasted with the cool water temperature which was provided to a radiant slab. But the natural air climatically outline development can accomplish C in space with no air dealing with unit by these systems. At the point when natural air is pumped it limits to 20% of power required for air taking care of units.



Figure 2.3- radiant cooling system utilizing cool water

3) Basic Section Radiant Cooling System Utilizing Cooling Tower: To keep up the slab temperature close to wet globule temperature otherwise called wet knob approach, the slab of radiant cooling is connected to a cooling tower. The dry globule and wet knob temperature very change in hot and dry atmospheres so this plan cools the space well impressively. The high measure of warmth is emanated from sun to largest amount of structures to possess space is overwhelmed by utilizing this framework



Figure 2.4 radiant cooling systems utilizing cooling tower



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- 4) Mean Radiant Temperature (MRT): As per ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) Standard 55-2010 characterizes six factors that influence warm human solace, they are (air temperature, radiant temperature, humidity, velocity of air, metabolism and clothing). Since the velocity of air, and metabolism and clothing are inhabitant reliant, initially just the air temperature, humidity factor, velocity of air, metabolism and clothing these can be observed and controlled by the HVAC system. Conventional aerating and cooling system normally screen and control air temperature, humidity, velocity of air of these space condition, overlooking radiant temperature.
- C. Control Selection For The Radiant Cooling Systems
- 1) Building Control Strategies
- a) Outdoor temperature sensor on the northern side of the building not exposed to sunlight.



Figure – 2.5 control strategy of a building

- b) The moisture and temperature sensors are kept in each zone which is used to monitor dew point temperature throughout the space.
- c) As the humidity sensors are placed in various rooms to calculate relative humidity in various rooms.
- *d)* Air sensing and temperature sensing thermostats are placed within each zone to manage air delivery for quick response cooling and local dehumidification. And temperature sensors manage to adjust the flow of temperature in required zone as it will indicates on the thermostat.
- e) Both detectors are frequently blended in single unit. Appropriate BMS based smart control systems are used.

#### III. BUILDING DETAILS

#### A. Building Description

In this project work the type of building for which a radiant cooling system with ceiling panels is designed and implemented, is a commercial type of application that is the buil -ding which is chosen is intended as to be used as a commercial building i.e. office buil -ding. The orientation of the building is such that as it is facing towards north direction Building is provided with complete glass portion or it may be called as envelope

#### B. Floors And Areas

The building comprises of four floors i.e. a ground floor, first floor, second and third floors respectively. As my project designed for a commercial space the whole amount of area where my radiant cooling system has been planned is about 84218sqft. And the TR 440 tonnage .The following are the areas block wise as my commercial building is divided into two sub portions at each floor.

Ground floor partition 1 : 8000sqft Ground floor partition 2 : 9340sqft First floor partition 1 : 10895sqft First floor partition 2 : 10313sqft

Second floor partition 1: 10525sqft

Second floor partition 2 : 10341sqft

Third floor partition 1 : 12152sqft

Third floor partition 2 : 12152sqft

There is different kind of spaces in this building as it is a commercial building such as lobby, lift section, corridor, and spaces for outlets.



- C. Plans Pictures
- 1) Ground Floor Plan



Figure 3.1: building plan (ground floor- partition 1)



Figure 3.2 : building plan (first floor – partition 1)



Figure 3.3 building plan( second floor –partition 1)



Figure 3.4 building plan (third floor –partition 1)



D. Designed Floors



Figure 3.5 building design plan (ground floor-partition 1)



Figure 3.6 building design plan (first floor – partition 1)



Figure 3.7 building design plan ( second floor -partition 1)



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Figure 3.8 building design (third floor-partition 1)

#### IV. HEAT LOAD CALCULATIONS

- To find the heat load of a office space we will need to know the following things:
- 1) Area of the space
- 2) The number walls facing to the solar
- 3) The number of occupants
- 4) The lighting load
- 5) The equipment load
- 6) Area of the unconditioned partition
- A. E 20 Sheet For The Ground Floor Partition 1 Heat Load

					Calc	ulatio	on				
Job Name Address Room sizes Largth Ft		Badjent		Space Used For			Office PARTITION 1				
				HYD			Area (3q50		215	1	
		Length (Ft)	Width (Ft)	Width (Ft) Height (Ft)			Height (Ft)				
80		76	10			Volume (CuEt)	8163.0				
Item		rea or		Gain or	Faotor	Btu/Hour	Date		08-17		
		uantity		p. Diff.			CONDITION		WB (F)	RH (%)	Qc/Lb
	ROO	M SENSIBLE	HEA'				Outside	112	77	3	8
Solar Gain -							Room	72	61	8	66
Glass - N	0	See x	23	х	0.56	0	Difference	41	XXX	XXX	20.4
Glass - NE	984	QQR X	12	х	0.56	6612				=	26
Glass - E	0	Sec X	12	х	0.56		Correction for Temp. Diff. (F)			=	27
Glass - SE	114T	See X	12	x	0.56	7708				-	61
Glass - S	0	Sec X	6	х	0.56	0				=	0.90
Glass - SW	110	See x	42.5	x	0.56		Occupancy (Nos)			-	\$10
Glass - W	0	See X	163	x	0.56		Lighting Load (W/3q5t)			-	16
Glass - NW	0	200 X	69	x	0.56	0	Equipment Load (kW)			-	82.0
Skyligts	0	Sec.x		x	0.58	0		OUTSIC	AIR AIR		
		- Walls & Roof					Per Person :	310	10	=	3100
Wall - N	0	See X	30	Fx	0.34	0	Ctop Per Stall	8152	0.01	=	82
Wall - NE	0	See x	36	Fx	0.34	0			1000		3182
Wall - E	0	Sea x	44	Fx	0.34	0					
Wall - SE	0	See X	44	Fx	0.34	0	Air Change Per Hour :		1	=	1359
Wall - S	0	SAR X	42	Fx	0.34	0	Ventiliation (Ctm)			=	3182
Wal-SW	842	SAMP.	-40	F x	0.34	8731	EFF. ROOM	SENS. H	EAT FACTO	192	
Wall - W	0	SAR X	38	Fx	0.34	0	Et Room Sens. Heat	5238T1		=	0.88
Wall - NW	0	368 X	32	Fx	0.34	0	Eff. Room Total Heat	595233			
(taal	0	Sec. x	61	F x	0.1	0	APPARATU	S DEW F	OINT (ADP)	100	
Trans. Gain -	Except	Walls & Roof					Indicated ADP (F)			=	54.0
All Glass	2241	Sec x	41	Fx	1.13	103826				=	52.0
Selition	223	SAMP X	36	Fx	6.3	3598	DEHL	IVIDIFIED	RISE		
Ceiling	0	SAR X	36	Fx	0.4	0	(Room Temp ADP) x CF		18	=	1
Floor	0	SAR X	31	Fx	0.5	0	DEH U	IDIFIE D	<b>6</b>		
Outside Air							Room Sens, Heat	176311		=	289.4.8
Vociliation	2181	COD X	41	Fx	0.11	14088	Opburg, Rise x 1.08	19		-	
mernal Heat							OUTL	ET TEM	P DIFF		
People	310	Nos. x	245			75950	Room Sens, Heat	5238T1		=	12
Light	8152	See X	1.5	W/SoR x	341	41697		29104		-	
Equipment	62	kW x		3410		211420		LY AR	CEN.		
		ble HeatSub T	otal			476247		623871		=	1866
Factor					10.0%	47625	Desired temp diffx 1.08	44	1.08	-	
	ROOM 2	ENSIBLE HEA	ат		1000	623871	counted write drive coo		1.600		
LITE CITY	RDO						ACTUAL T R			-	66.7
Contillation	2181	Cita x	20.4	Gelb x	0.068	4442	DEHUMIDIFIED CFM/8FT			-	11
			20.4	grow A	0.000					-	
People Bective Room	310	Nos.x Reat Sub Total	205			63550	8FT/ TR OF REFRIGN.			-	12.3
Factor	Same 1				5.0%	3398	RECOMMENDED				
	noout -	ATTAIT LIE AT			20%	71382		-	74.1		
		ATENT HEAT	-				AS 10% SAFETY FACTOR AS PER OFM	-	67.4		
EFFECTIVE	ROOM 1	TIDE AR HEA				686233	AS PER UPM		07.4		
Sensible	2182	CRA X	41	Fx	DOT	126790					
Latent	2181	Con x	20.4	Gelb x	0.61	39721			1000		
Grand Total k	Heat Sub	) Total				761744			74.1		
	_				5.0%	38087	SUGGE STED CFM		3841		



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#### B. HAP

The valuation of heat load calculations is also done with the HAP software.

Hourly Analysis Program (HAP) is a PC based programming which encourages architects to plan a HVAC framework for different structures. As it contains different tools in which one is used for load calculations and for designing the systems another one it is help full for simulating use of energy and to find the cost of energy to be spent for a building. The functionality method to find the load it goes with the ASHRAE endorsed methods and these methods for energy analysis with hour by hour energy simulation approaches.

HAP program comes as two same but in two different products.

- *1)* HAP System Design Load
- 2) 2. HAP

Overhead Light Eisture Type	Recessed, unvented	People Qccupancy	400.0	People .
Wallage	2.00 W/M •	Activity Level	Office Work	
Ballast Multiplier	1.00	Sensigle	245.0	BTU/hs/perso
Schedule	Light Schedule	Laterit	205.0	BTU/hs/perso
Task Lighting			People Sche	dule 💌
W∦tage	0.00 W/R <sup>4</sup>	Miscelaneou	s Loads	
Schedule	(none)	] Sensjble	0	BTU/hr
Electrical Equip	ment	Schedule	(none)	
Wajtage	80000.0 Walts	Lategt	0	BTU/hr
Schedule	Equipment Schedule	Schedyle	(none)	

- C. HAP Summary Reports Of Ground Floor
- 1) Air System Sizing Summary For Ground Floor Partition 1

Air System Information Air System Name	OF PARTITION 1	Number of zones	1
Equipment Class			8000.0 H
Air Sinden Tipe			lerabad, India
a specific sector se	acons.	np	ALL STAR. INC.
Sizing Calculation Infor			
Zone and Space Sizing	Meth od:		
Zone CRM	ion of space sinfow ster-	Calculation Months	Jan to Des
Space CFM	individual pesk space keds	Siding Data	Calculated
Central Cooling Coil Siz	ing Data		
Exercision 1	46.9 Torm	Losd occurs at	Jun 1500
Thisful but	295.6 MBH	OA DE I WE	93.0167.0 *F
SOLDY OFFIC	268.3 MBH	Encoding DB / WB	79.5/64.0 F
CHECKER ALMONTHE	12325 GEM	Leaving DB / WB	57.0155.5 *F
Bin 1864 (MM	12325 GEM	CollADP	54.5 °F
Relation and The	12325 CFM	Bytess Factor	0.100
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	255.0	Design supply temp	58.0 F
ONT M			
915A	47.1	Zone Tetat Check	0 of 1 OK
Water flow @ 10.0 °F rise		Zore <sup>®</sup> Estat Überk Mai zine seriperatue derilation	0.0 F
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2) Air System Sizing Summary For First Floor Partition 1

Sizing Calculation Information Zone and Space Sizing Methods: Space CFM. Sam of space alifiere reles Space CFM. Individual peak space loads Sizing Data Central Cooling Coil Sizing Data Set Set Space Set Set Set Set Set Set Set Set Set Se	1 10895.0 #2
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Space CPKI         Individual peak space loads         Sting Dira	
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vision         296.6         MBH         Ox CB / VKS           best with         296.5         MBH         Control / VKS           bit with         200.5         MBH         Freemang VKS           bit with         200.5         CFM         Events DB / VKS           bit with         200.5         CFM         Events DB / VKS           bit with         200.5         CFM         Events DB / VKS           bit with         0.055         Breading SH         Map           bit with         0.055         Breading SH         Map           with with         0.055         Breading SH         Map           Water flow QB 10.0 °F rise         59.36 gpm         MB zote Support Nap         Events SH           Central Heating Coll Sizing Data         224.5         MBH         Event OB / Log 0D         Event OB / Log 0D           Water flow QB 20.0 °F drop         24.47 gpm         Event OB / Log 0D         Event OB / Lo	
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totage         12225 CFM         Coll ADD           totage and to	79.5/64.0 °F
bit main million         1225 CFM         Spass Factor           bit main million         0.555         Data factor           bit main million         0.555         Data factor           bit main million         24.6         Data factor           bit main million         25.765         CFM         Spass Factor           bit main million         25.765         CFM         Load occurs at 25.766         CFM           bit main million         25.766         CFM         But Data         Spass Factor           bit main million         25.766         CFM         But Data         Spass Factor           bit main million         25.766         CFM         But Data         Spass Factor         Spass Factor           bit main million         25.766         CFM         But Data         Spass Factor         <	57.0/55.5 °F
Sons as as         0.955         Seining Shi           Visator flow (g) 10 0 °F rise         2500         Design splithing           Water flow (g) 10 0 °F rise         93.35 gpm         Main zare temperature sources           Central Heating Coll Sizing Data         244.5 MBH         Land encore at           Water flow (g) 200 °F drop         244.6 MBH         Land encore at           Water flow (g) 200 °F drop         244.7 MBH         End encore at           Water flow (g) 200 °F drop         244.7 MBH         End encore at           Water flow (g) 200 °F drop         244.7 gpm         End encore at           Water flow (g) 200 °F drop         244.7 gpm         End encore at           Start (g) 200 °F drop         244.7 gpm         End encore at           Start (g) 200 °F drop         244.7 gpm         End encore at           Start (g) 200 °F drop         244.7 gpm         End encore at           Start (g) 200 °F drop         244.7 gpm         End encore at           Start (g) 200 °F drop         244.7 gpm         End encore at           Start (g) 200 °F drop         244.7 gpm         Fan encore the           Start (g) 200 °F drop         210 °F fan encore the         CrMitt'	54.5 °F
ma         255.0         Design suppress           Water flow (2) 10.0 °F in se         47.1         Zore 1° standCreak           Water flow (2) 10.0 °F in se         93.16 gpm         Jore 1° standCreak           Water flow (2) 10.0 °F in se         93.16 gpm         Mar zore temporaruse dwater           Verater flow (2) 10.0 °F in se         93.16 gpm         Mar zore temporaruse dwater           Verater flow (2) 10.0 °F in se         244.6 MBH         Load occurs at           se of a se me         25766 CPM         Bill(t)(t)(t)           Water flow (2) 00 °F in cep         244.17 gpm           Water flow (2) 00 °F in cep         244.17 gpm           water flow (2) 00 °F in cep         244.17 gpm           water flow (2) 00 °F in cep         244.17 gpm           water flow (2) 00 °F in cep         244.17 gpm           water flow (2) 00 °F in cep         244.17 gpm           water flow (2) °F in cep         23093 CPM         Fan motor tHP           water flow (2) °F in table         CPM fit         Fan motor HP	0.100
rapping         rapping         Zone T-statCheck         Zone T-statCheck           Weater flow (2) 10 0 °F rise         9316 gpm         Zone T-statCheck         Zone T-statCheck           Weater flow (2) 10 0 °F rise         9316 gpm         Zone T-statCheck         Zone T-statCheck           Weater flow (2) 0 °F rise         244.6 MBH         Load occurs at         Zone T-statCheck           Weater flow (2) 0 °F rise         25786 CFM         Status occurs at         Status occurs at           Water flow (2) 0 °F drop         244.7 gpm         Status occurs at         Status occurs at           water flow (2) 0 °F drop         244.7 gpm         Status occurs at         Status occurs at           water flow (2) 0 °F drop         244.7 gpm         Status occurs at         Status occurs at           water flow (2) 0 °F drop         244.7 gpm         Status occurs at         Status occurs at           water flow (2) 0 °F drop         22093 CFM         Fan endore RM         Status occurs at           water flow (2) 0 °F drop         3.2 Z         Fan state         Content           Water flow (2) 0 °F drop         3.2 Z         Fan state         Content	58.0 °E
Water Row (2) 10.0 °F rise         95.36 gpm         Mar are temperature sources           Central Heating Coll Sizing Data         244.6 MBH         Land occors at           Ser at a m         25766 CPM         Billighth           Ser of a m         25766 CPM         Entr D0 / Leg DD           Water fore (2) CP         244.7 gpm         Entr D0 / Leg DD           Ser of a moder to m         23093 CPM         Fan moder to M           Ser of a moder to m         3.22 Fan state         CPM Rt*           Or Mit*         CPM Rt*         Fan state	0 of 1 OK
Supply Fan Sizing Data         244.6 MBH         Load occurs at           Sort is min.         25766 CPM         BitUgerit           Wind Net.         92 2016 CPM         BitUgerit           Sort is min.         25766 CPM         BitUgerit           Sort is min.         25766 CPM         BitUgerit           Supply Fan Sizing Data         State State         25765 CPM           Supply Fan Sizing Data         23093 CPM         Fan molor BHP           Search CPM         23093 CPM         Fan molor WM           CPT Mit*         CPT Mit*         Fan state	0.0 °F
Water few @ 200 °F drop     24.47 gpm       Supply Fan Sizing Data     25756 CPM       war to Pit     25756 CPM       beer oft     23093 CPM       ware to the comparison of the	Dec 0900 9.9 56.7 / 61.9 °F
www.mc/m         25785 CPEM         Fan molor BHP           bases 014         23093 CPM         Fan molor WU           www.mc/me         322         Fan molor WU           CPEM/R*         Fan state         CPEM/R*	
betry cm         23093 CFM         Fun motor kW           3.202         CFM Mt         State	
Anse no cover 3.22 Fan static CPM/R* Dutdoor Ventilation Air Data	0.00 BH
CFM/ft*	0.00 kW
Dutdoor Ventilation Air Data	0.00 in w
6553 CFM CFMperson	
	16.20
0%4 0.81 CFM/ft <sup>2</sup>	CFMperson

#### 3) Air System Sizing Summary For Second Floor Partition 1

Air System Information Air System Name	Work station SF 1	Number of zones	1
Failmant Class		Floor Alea	10525 ft*
Air Sistem Trop		Location.	
Sizing Calculation Inform			
Zone and Space Sizing N	lethod:		
Zone CFM	Sum of space airflow rates	Calculation Months	Jan to Dec
Space CFM	Individual peak space loads	Sizing Data	Calculated
Central Cooling Coil Siz	ing Data		
Test of lead	56.6 Tors	Load occurs al	Jun 1500
The other	489.7 MBH	CA DB / WB	93.0/67.0 °F
Cersbirasi kal		Entering DB / WB	79.5/64.1 °F
Cei CAT # Lat 1910	20348 CEV	Leaving DB ( WB	57.0/55.6 F
libition), CPIL	20348 CEV	Chi ADP	54.5 °F
Sin d'orik zne CRI		Bypess Factor	0.100
Deroble ballet o		Resulting RH	50 %
MTp:		Design supply temp	58.0 °F
COM-	60.1	Zone Tetat Check	O of 1 OK
	97.99 gpm	Max pre benperature deviation.	0.1 °F
Central Heating Coil Siz	ing Data		
	91.3 MBH	Load occurs at	Jan 1100
Coil CFM at Jan 1100	20348 CFU	BTU(In-0*)	11.2
Max coll CFM	20348 CFM	Ent DB/Lvg DB	55.57 51.3 °F
Water flow @ 20.0 *F drop	9.14 gpm		
	Sector Spectra		
Supply Fan Sizing Data			
Supply Fan Sizing Data		Fas motor BHP	0.00 EHP
Actual max CFM	20348 CFM		
Actual max CFM Standard CFM	20348 CFM	Fan notor BHP. Fan notor KW Fan Stote	0.00 KW
Actual max CFM Standard CFM Actual max CFMft*	20348 CFM 7255 CFM 2.50 CFM1*	Fan motor KW	0.00 KW
Actual max CFMStandard CFM	20148 CFM 7255 CFM 2.50 CFM1* Data	Fan motor KW	0.00 kW 0.00 h Mg

4) Air System Sizing Summary For Third Floor Partition 1

	Third floor prt. 1	Number of zones	
Equipment Class		Floor Area	12152.0 ft*
Air System Type	SZCAV	Location.	Hyderabad, India
Sizing Calculation Infor Zone and Space Sizing I	mation Method:		
Zone CFM	Sum of space airflow rates	Calculation Months	
Space CFM	Individual peak space loads	Sizing Data.	Calculated
Central Cooling Coil Siz	zing Data		
Tay of lac	61.6 Tons	Load occurs at	Jun 1500
Total coll load	489.7 MBH	CA DB / WB	
Sensible milling	442.1 MBH	Entering DB / WB	79.5/64.1 'F
ChiCRI # Jur 160		Leaving DB / WB	57.0/55.6 °F
Iter bbgi, CRI.	20348 CFM	CHI ADP	54.5 °F
Sam of gook zine (Fil	20348 CFM	Bypass Factor	0.100
Senshie testration	0,903	Resulting RH	50 %
80m	199.8	Desion supply tenp	
(7.0×0)	60.1	Zine T-tat Check	0 of 1 OK
Water flow @ 10.0 °F rise	97.99 apm	Nax zone temperature deviation	0.1 °F
	ring Data		
Central Heating Coil Siz Max col load. Coil CFM at Jan 1100 Max coll CFM. Water flow @ 20.0 "F drop.	91.3 MBH 20348 CFM 20348 CFM	Load occurs at BTU(m-th) Ent DB / Lvg DB	11.2
Max coil load. Coil CFM at Jan 1100 Max coil CFM.	91.3 MBH 20348 CFM 20348 CFM	BTU((m-ft*)	11.2
Max col load Coll CFM at Jan 1100 Max coll CFM Water trow @ 20.0 "F dtop. Supply Fan Sizing Data Actual max CFM	91.3 MBH 20148 CFM 20148 CFM 9.14 gpm 20148 CFM	BTJ(m41) Ent DB /Lvg DB	11.2 55.6 / 61.3 °F 0.00 BHP
Max col lod. Ceil CFM at Jan 1100 Max col CFM. Water flow @ 200 "F stop. Supply Fan Sizing Data Actual max CFM	91.3 M3H 28348 CFM 28348 CFM 9.14 gpm 28348 CFM 28348 CFM 8312 CFM	BTU(p-41) Ent. DB / Lvg QB Fan motor BHP Fan motor BHP	0.00 BHP 0.00 kW
Max col load Coll CFM at Jan 1100 Max coll CFM Water trow @ 20.0 "F dtop. Supply Fan Sizing Data Actual max CFM	91.3 M3H 28348 CFM 28348 CFM 9.14 gpm 28348 CFM 28348 CFM 8312 CFM	BTJ(m41) Ent DB /Lvg DB	0.00 BHP 0.00 KW
Nax col bod. Cel DFM at Jan 1100. Nax col DFM at Jan 1100. Nax col DFM Vater for (g 200 °F dop. Supply Fan Sizing Data Actual max CFM Actual max CFM Actual max CFM/fi Outdoor Ventilation Air	91.3 UGH 2934 CFU 2934 CFU 9344 CFU 9.14 gpm 29345 CFM 250 CFMT <sup>2</sup> Data	BTUp-47) Ent DB / Lyg QB Fan todo: BHP Fan todo: W Fan todo: W Fan todo: W	112 55.6 / 61.3 Ŧ 0.00 BHP 0.00 KW 0.00 h wy
Max col lod. Ceil CFM at Jan 1100 Max col CFM. Water flow @ 200 "F stop. Supply Fan Sizing Data Actual max CFM	91.3 184 2834 CM 2834 CM 9.34 gpn 2834 CFM 832 CFM 832 CFM 232 CFMTP Data 359 CFM	BTU(p-41) Ent. DB / Lvg QB Fan motor BHP Fan motor BHP	112 55.6 / 61.3 Ŧ 0.00 BHP 0.00 KW 0.00 h wy



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#### V. DUCT DESIGNING

The duct element is an important part of an air conditioning system and is categorized under the air distribution system. The ducts are the enclosed passage way that are meant to carry the conditioned air to the space from the system outlet and also to carry away the exhaust or return air from the spaces back to the system for conditioning.

It is important that the design of duct system must be carefully done as it greatly affects the design of air conditioning system. Also, the execution of the duct work must be done under close supervision as any errors in the duct installation may lead to inefficiency of the plant. The main factor to be designed in terms of duct designing is the size of the duct that is suitable to convey the desired amount of air at proper flow rate and pressure. The size

should be optimum corresponding to the air flow. Any disparity in the design of duct may lead to drawback like surplus cost expenditure, noisy operation, and excess energy usage. The air flow rate should be maintained throughout the space as per the cfm provided, also the pressure and the velocity which ensure the effective air distribution in a room and enhance the comfort.

#### A. Classification Of Ducts

Based on the shape of duct, the duct are classified as

- 1) Circular or round ducts
- 2) Rectangle or square ducts
- 3) Oval ducts

#### B. Methods Of Ducting Designing

There are mainly three methods of duct designing they are;

- 1) Constant friction loss or equal friction method
- 2) Velocity reduction method
- 3) Static regains method

#### C. Equal Friction Method

It is a straightforward strategy for estimating the conduit and the essential standard of this technique is to plan a pipe with square with grating misfortune all through the ducting i.e. the weight drop in a conduit will be kept consistent all through its length. To process the conduit measure, a product named pipe sizer created by Mc Quay is utilized as a part of which the information for measure estimation is characterized regarding the required wind stream rate and the consistent erosion misfortune rate. In this manner, for numerous spaces just the wind current rate is differed and the erosion rate is kept steady. The grating misfortune is for the most part characterized regarding creeps of water segment per 100 feet (in W. C. per 100 ft) and the standard average plan rate of grinding misfortune to be kept up ranges up to 0.1 in W.C per 100 ft for business applications

68*F Air ST	Р		-	
		0.075	Ib/ft <sup>2</sup>	-
Fluid viscosi	ity	0.0432	lb/ft-h	
Specific Hea		0.24 Btu/lb*F		
Energy facto	or	1.08	Btu/h*F-o	cfm
Flow rate	7860	cfm		
Head loss	0.08	in.WC/100 ft		
	1437.2	fpm		
Equivalent diameter	31.7	] in		
Duct size	20	in X	44	in
Equivalent D	)iameter	31.82	in	
Flow Area		5.522	ft <sup>2</sup>	
Fluid velocit	y	1423.4	ft/min	
	mber	393,164		
Reynolds Nu				
Reynolds Nu Friction fact		0.0163		
	or	0.0163 0.1263	in.WC	



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#### D. Pipe Sizing

The cooling water pipe sizing can be done either manually using the schedule 40 chart from ISHRAE or by using the software named pipe sizer developed by Mc Quay. The main consideration or the input parameters in the design of cooling water pipe size are the water consumption rating and the head loss due to friction. The water consumption rating is defined in terms of gallons per minute (GPM) and the friction loss is defined in terms of feet of water per 100 feet (ft/100 ft). Typical design standards of these two parameters are specified below. Water consumption rate -3 gpm / TR for closed cycle Friction loss – upto 2.5ft per 100ft for commercial applications

#### VI. CONCLUSION

A complete design of a radiant cooling air conditioning system is presented under this project work and the following results are obtained during the course of this project. The net heat load estimated for the commercial building is 440 TR throughout the floors. The purpose of the project was to cool the spaces through radiant cooling frameworks using the ceiling panels, as this system is also called as hydronic system due to utilization of water. The cooling water pipe size is obtained as 4 inches in diameter corresponding to the total water consumption rating of 138 gpm. For the interior region with internal load, the cooling rate difference ranged from 7%-26% at surface level as its mainly depends on fraction of internal laods. The pump capacity determined is 38 H. P This will results in the higher radiant fraction in the process of heat gain generate bigger difference in peak cooling rates. As in this we are using ceiling panel 4.5% amount of cash been saved through ceiling panel when compared to other systems. Material cost is 40% less. The consumption of electricity usage is 30% when compared to the other traditionalHVAC systems the result has shown 50% more efficiency. The project is productively consummate and given reasonable results.

#### REFRENCES

- [1] Refrigeration and air conditioning by domkundwar, aurora.
- [2] Lehmann, B.M gwerder, V. dorer and F. renggli (2011) thermally activated building system.
- [3] ISHRAE handbook 2007
- [4] ASHRAE handbook 2001
- [5] www.mcquay.com
- [6] Engineering design guidelines fluid flow hydraulics sizing selection http://kolmetz.com
- [7] Advantages of radiant cooling system by Robert cubik june 2016











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