A PROJECT REPORT

ON

"DESIGN OF VRF SYSTEM"

Submitted by

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In partial fulfillment for the award of the Degree

Of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING
UNDER THE GUIDANCE

Of

Prof. RAHUL THAVAI



DEPARTMENT OF MECHANICAL ENGINEERING

ANJUMAN-I-ISLAKALSEKAR TECHNICAL CAMPUS NEW PANVEL,

NAVI MUMBAI – 410206

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"DESIGN OF VARIABLE REFRIGERANT FLOW (VRF) SYSTEM"

Submitted to

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In Partial fulfillment of the Requirement for the Award of

Bachelor's degree in Mechanical Engineering By

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ANJUMAN-I-ISLAM'S KALSEKAR TECHNICAL CAMPUS, NEW PANVEL

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UNIVERSITY OF MUMBAI



ANJUMAN-I-ISLAM KALSEKAR TECHNICAL CAMPUS NEW PANVEL

(Approved by AICTE, recg. By Maharashtra Govt. DTE,

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This is to certify that the project entitled

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To the Kalsekar Technical Campus, New Panvel is a record of bonafide work carried out by him under our supervision and guidance, for partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechanical Engineering as prescribed by **University Of Mumbai**, is approved.

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APPROVAL OF DISSERTATION

This is to certify that the thesis entitled

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Project I Approval for Bachelor of Engineering

This Project entitled "DESIGN OF VRF SYSTEM" by Ansari Mohd Uzer, Ansari Mohd Danish, Niwshekar Ayman, Pagarkar Junaid is approved for the degree of Bachelor of Engineering in Department of Mechanical Engineering.

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Declaration

We declare that this written submission represents our ideas in our own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or violation falsified any idea/data/fact/source in my submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.



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ABSTRACT:

Air conditioning demand is rapidly increasing in many parts of the world especially in moderate climate. Air conditioners and refrigerators are the only equipment consumes more electricity say 70 percent house hold articles this result in drastic electricity demands on hot summer days which causes unwanted increase in the use of fossil fuel and nuclear energy which leads to global warming and air pollution. The VRF system uses R410A as refrigerant because it contains only Fluorine hence it has very low global warming potential. VRF systems are enhanced versions of ductless multi-split systems, permitting more indoor units to be connected to each outdoor unit and providing additional features such as simultaneous heating and cooling and heat recovery. VRF technology uses smart integrated controls, variable speed drives, refrigerant piping, and heat recovery to provide products with attributes that include high energy efficiency, flexible operation, ease of installation, low noise, zone control, and comfort using all-electric technology. VRF systems are very popular in Asia.

This thesis presents design of Variable Refrigerant Flow (VRF) system for an office building in Vashi, Navi Mumbai. The VRF system was selected as the space saving was priority of the client. The system is designed using ISHRAE hand book and Toshiba manual. The heat load was calculated considering various factors such as outdoor condition, heat gain through glass, transmission gain through wall etc. As per the heat load calculated proper selection of outdoor unit and indoor unit was done using Toshiba manual. The schematic of pipe and indoor is displayed considering cost effectiveness. The obtained results were validated by the industry.

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Keywords:

R410A, ISHRAE, outdoor unit, indoor unit, cassette, British Thermal Unit, compressor

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CHAPTER 1

1. INTRODUCTION

1.1 Background:

Variable refrigerant flow (VRF), also known as variable refrigerant volume (VRV), is an HVAC technology invented by Daikin Industries, Ltd. in 1982. Like ductless mini splits, VRFs use refrigerant as the cooling and heating medium.

Variable refrigerant flow (VRF) systems vary the flow of refrigerant to indoor units based on demand. This ability to control the amount of refrigerant that is provided to fan coil units located throughout a building makes the VRF technology ideal for applications with varying loads or where zoning is required.

VRF systems are available either as heat pump systems or as heat recovery systems for those applications where simultaneous heating and cooling is required. In addition to providing superior comfort, VRF systems offer design flexibility, energy savings, and cost-effective installation

1.2 VRF Technology:

In a VRF system, multiple indoor fan coil units may be connected to one outdoor unit. The outdoor unit has one or more compressors that are inverter driven, so their speed can be varied by changing the frequency of the power supply to the compressor. As the compressor speed changes, so does the amount of refrigerant deliver by the compressor.

Variable Refrigerant Flow (VRF) system is an air conditioning system which uses refrigerant as a medium to provide zonal cooling and heating. It varies the flow of refrigerant to each room as per the required condition, the compressor used is driven by inverter so that by changing the speed of compressor the flow of refrigerant can be varied hence, the variable flow system. This ability to control the flow of refrigerant makes the VRF system ideal for applications

with varying load or where zonal heating and cooling is desired. VRF systems provide design flexibility, energy savings, and cost-effective installation along with superior comfort.

Each indoor fan coil unit has its own metering device that is controlled by the indoor unit itself, or by the outdoor unit. As each indoor unit sends a demand to the outdoor unit, the outdoor unit delivers the amount of refrigerant needed to meet the individual requirements of each indoor unit.

These features make the VRF system ideally suited for all applications that have part load requirements based on usage or building orientation, as well as applications that require zoning

1.3 Problem Definition:

The traditional air conditioning system used takes up a lot of space and maintenance cost is quite high. moreover, they use of ducts which introduce cooling and heating losses, besides the control over the flow of refrigerant or coolant is not possible as the pump speed cannot be varied. They also have high operation cost in order to solve these problems we have implemented VRF system considering the required cooling load.

1.4 Project Aim & Objectives:

1.4.1 Aim:

- The main aim is to design and install a Variable refrigerant flow (VRF) system in MTNL building.
- To provide heating ventilation and cooling by providing system which is environmentally friendly.
- To provide cooling and ventilation in economic cost
- To provide consistent comfort to occupants
- To ensure the quite operation of the system
- To design the system such that it provides zonal heating and cooling

1.4.2 Objectives:

- To design energy efficient system
- To provide heating ventilation and cooling by providing system which is environmentally friendly.
- To provide cooling and ventilation in economic cost.
- To provide consistent comfort to occupants.
- To ensure the quite operation of the system.
- To design the system such that it provides zonal heating and cooling



CHAPTER 2

2. LITERATURE SURVEY

2.1 Variable Refrigerant Flow Systems (GSA journal)

Brian Thornton and Anne Wagner published a journal for the General Service Administration of the USA. This journal gives guidelines for application of VRF system. According to it VRF systems can achieve 30% and higher HVAC energy cost savings relative to minimally code conventional compliant systems, or older inefficient systems. Buildings switching from gas heat to VRF systems offer large energy savings, but because of the price differential between electricity and gas, the utility bill savings will be greater when switching to VRF systems. The best opportunities for VRF systems include buildings with these target characteristics like inefficient HVAC systems and high energy costs, lack of cooling or inadequate cooling capacity, although adding cooling capability or capacity may increase total energy usage despite possible reductions in fan and heating energy usage, new building projects that can take advantage of opportunities to reduce floor-to-floor height, or increase usable floor space by removing mechanical equipment from inside the main building areas, VAV systems with electric reheat or heat pumps with electric back-up heat. Up to a 70% reduction in HVAC energy is possible from a VRF system with exhaust air heat recovery when compared to a VAV system with electric reheat, according to an energy modeling study (Hart and Campbell 2011), significant heating requirements - the Midwest and Northeast are good places to look for opportunities in this regard.

2.2 Installation guide VRF system

It is a manual published by Ingrensoll Rand. It gives step by step guide lines for installation of VRF system. Various safety precaution is explained. Guidelines for proper selection of tools and pipe dimeters is given. It explains orientation of outdoor unit and safety measures while

transporting it as per the required tonnage. Various test that need nbe carried out after installation are explained unit.

2.3 Comparative Thermodynamic and economic analysis of conventional HVAC and

VRF system

Emrah` zahi, Aseguil Abusoglu,A. ihsan Kutlar,Oguzhan Dagci carried out an experiment where they did thermodynamic and economic analyses of an existing social and cultural building which has a heating and cooling area of 8852 m² by comparing of a conventional HVAC and a VRF system. A novel contribution is given to the open literature by comparing two systems with actual data measured from the existing system. This study contains insulation, heating and cooling accounts of a building together. In this paper, VRF system is modelled to the existing building for the comparison of the conventional HVAC system. Both systems have been compared in terms of heating and cooling capacity, initial, operation and maintenance costs. It is found that the VRF system is more economic and efficient such that the VRF system is found to have 44% cost profit when compared with the conventional HVAC system.

2.4 A review of HVAC with VRF system

Kartik Patel did a research on VRF system and its energy saving potential in India. According to the study VRF technology is relatively new in India and gained the momentum after 2007. So, this is been relatively new and efficient way to design HVAC system with VRF technology. VRF technology uses smart integrated controls, variable speed drives, refrigerant piping, and heat recovery to provide products with attributes that include high energy efficiency, flexible operation, ease of installation, low noise, zone control, and comfort using all-electric technology. Still efficiency and energy saving depend on many variables which controls heat load of the building. So, energy saving from VRF technology may vary from 10% to 40%

2.5 Design of HVAC with VRF system for a space house in Ahmedabad

Kartik M Patel a PG student designed VRF system for a space house. Various heat load gain, energy efficiency ratio (EER) was calculated. The cost of the project was estimated. Design has been done using ISHRAE standards.

2.6 Developed a new VRF simulation module based on physics in Energy Plus version

With their comparison between measured and simulated results, normalized mean bias errors (NMBEs) were 2.8% and 4.5% for cooling and heating operations. Saving potential of VRV air conditioners could be high as 18 % compared to the energy consumed by split air-conditioning systems when used for appropriate applications. Therefore, the VRV system can be considered as a potential candidate for the installations where the building occupancy and cooling load are regularly varying. Further, Chiller (Central) air-conditioning system can also be considered as a potential candidate as it performs almost efficiently as the VRV system. It consumes around 4 % more energy than VRV system.

The major objective of the research study was to analyses the suitability of VRV air- conditioning system, analyses the actual saving potential and cost effectiveness of VRV air- conditioning system compared to the other available types of air-conditioning systems and access the maintainability of VRV air-conditioning system. (UNIVERSITY OF MORATUWA)

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CHAPTER 3

3. TOTAL COSTING

	Cost of AIR CONDITIONING	
1	Supplying, Installing, Testing & commissioning of outdoor type of following capacity air cooled 100% inverter compressor based VRV/VRF system using R410A/R407 refrigerant, i/c first fill of refrigerant. The system shall be suitable to operate on 3 phase, 415 V 50 HZ AC power supply and shall comprise of DC Twin Rotary/Scroll compressor, air cooled condensers and its fan with motor, micro-processors controls, control panels, suitable starters, along with internal control and power wiring internal interconnecting refrigerant pipes, charging ports, system single enclosure (the electrical and electronic components assemblies shall be protected with IP - 55 enclosures). Unit shall be complete with suitable safety steel structure COP levels not less than 5.25 at 50% capacities.	Legal Consultation of the second seco
a)	VRF Outdoor Units (28 HP) combination of 14.0 HP X 2Nos	6 Each 577318 Each 3463908.00
2	SITC of Cassette VRF type four directional air flow DX split indoor air conditioning units of the following capacity for mounting inside false ceiling, each comprising of cooling coil, blower with multispeed motor, electronic expansion value ,supply and return air grill, filter, insulted connection of refrigerant circuit, intake airport for fresher air entry, condensate water drain	AI - INDI.

	pump with electronic level sensor complete, suitable to operate from central remote control & installation from ceiling with all required supports, anchor fasteners hardware's, interconnecting refrigerant copper piping, valves, supports etc. including termination at nearest power outlet with copper wire of 3C x 2.5 sq.mm in metallic flexible conduit and interlocking with outdoor units including remote controller. Units shall confirm to the detailed specification of the tender document.		TEC			
a)	1.6 TR	2	Each	47117	Each	94234.00
b)	2.5 TR	24	Each	52696	Each	1264704.00
c)	3.0 TR	31	Each	59516	Each	1844996.00
3	Supplying & fixing Interconnecting refrigerant copper piping work with supplying and fixing (19 mm thick) closed cell elastomeric nitrile rubber tubular insulation between each set of indoor & outdoor units as per specifications, all piping inside the building shall be properly supported with MS hanger etc. complete as required. The piping shall be laid in masonry shafts, wall, roof/ ceiling, partly in existing pipe well supported at specific intervals with wooden patterns and screwed with anchor fasteners. (The insulation shall be 19 mm thick of NITRILE RUBBER).	AND	No. No.	Acres (U)	EW PANVE	
a)	47.625mm OD or 1 7/8" dia	130	Meter	1677	Meter	218010.00
b)	41.275mm OD or 1 5/8" dia	130	Meter	1410	Meter	183300.00

c)	34.925mm OD or 1 3/8" dia	60	Meter	1286	Meter	77160.00
d)	28.575 mm OD or 1 1/8" dia	75	Meter	1019	Meter	76425.00
e)	25.4 mm OD or 1" dia	135	Meter	966	Meter	130410.00
f)	22.225 mm OD or 7/8" dia	150	Meter	841	Meter	126150.00
g)	19.05 mm OD or 3/4" dia	95	Meter	705	Meter	66975.00
h)	15.875 mm OD or 5/8" dia	150	Meter	580	Meter	87000.00
I)	12.7 mm OD or 1/2" dia	130	Meter	501	Meter	65130.00
j)	9.525 mm OD or 3/8" dia	150	Meter	399	Meter	59850.00
k)	6.35 mm OD or 1/4" dia	130	Meter	260	Meter	33800.00
4	SITC of insulated Copper Refrigerant Branch Kit/ Refinet Joint for VRV piping complete as required. The insulation shall be 19 mm thick of NITRILE RUBER.	57	Each	3864	Each	220248.00
5	Supplying, installation, testing and commissioning of heavy gauge UPVC drain Piping for the VRV system fully insulated with 6mm thick NITRILE RUBBER insulation with adequate supports as per specification and instructions of Engineer in charge etc. as required.	BA1	IND	A		
a)	25 mm dia.	90	Meter	144	Meter	12960.00

b)	32 mm dia.	290	Meter	177	Meter	51330.00
c)	40mm dia.	90	Meter	202	Meter	18180.00
d)	50mm dia.	70	Meter	255	Meter	17850.00
6	Supplying, laying and fixing control cum transmission cable between indoor and outdoor units of size 2 core x 2.5 sq.mm XLPE/PVC insulated copper conductor in PVC conduit including accessories like cable glands & Lugs etc. as required.	800	Meter	132	Meter	105600.00
7	Supplying Fabrication of MS frame structure suitable for mounting outdoor VRF unit mesh out of suitable thickness and section i/c cutting, welding and panting with 2 coats of synthetic enamel paint after primer, fixing on wall with anchor fastener etc. complete as required.	1250	Meter	Kg.	Meter	190000.00
	TOTAL COST			0	WP	8408220.00

Table 1. Total Cost of Project

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CHAPTER 4

4. METHODOLOGY:

4.1. Steps of Methodology

The following are steps followed by industries for designing VRF system

- **Site visit of engineer:** the site engineer visits the site and analyze the site and gets the architectural layout.
- Area measurement: This involves calculation of area which requires cooling.
- Heat and cooling load Calculation: Heating and cooling load are calculated considering outdoor condition, heat gain through wall, ceiling, roof etc. Heat load calculation is a fundamental skill for HVAC designers and consultants. Consider that space cooling is among the highest energy expenses in buildings, especially during the summer. However, to properly size a space cooling system, first we must know the amount of heat that must be removed this is precisely the purpose of heat load calculation. Heat in buildings can come from internal sources such as electrical appliances, or from external sources such as the sun, heat gain through wall, ceiling, roof. A heat load calculation considers all sources present and determines their total effect.
- Selection of indoor & outdoor unit, line of piping: Based on the heat load calculated selection of indoor and outdoor unit is done. As per the selected outdoor and indoor units pipe dimensions for main line and branches is done using Toshiba manual.
- Layouts & drafting: The layout of line of piping from outdoor to indoor is created using drafting software like Auto CAD. the layout drawing is a running record of ideas and problems posed as the design evolves. In most cases the layout drawing ultimately

becomes the primary source of information from which detail drawings and assembly drawings are prepared by other draftsman under the guidance of the designer.

- **Purchasing and BOQ:** Purchasing is a business or organization attempting to acquire goods or services to accomplish its goals. Although there are several organizations that attempt to set standards in the purchasing process, processes can vary greatly between organizations. The purchasing department purchase the materials required like steel sheets for ducts, cooper pipes.
- Material procurement: Procurement is a term describing the purchasing process for goods and services. In material procurement is the process by which the materials required are selected, ordered, invoiced, paid for and delivered to the site. procurement typically includes expediting, supplier quality, and transportation and logistics
- **Segregation:** it involves systematic sorting of material and storing it using various work place organization technique to save space and time.
 - supporting is structure used to hang the indoor cassette and branch controller and other components
- **Drain line/Condensate line:** The condensate line is one of the most important components of your HVAC system. Your condensate line, also known as a condensate drain line or condensate drain does several jobs, but none are more critical to the functionality of your appliance than draining excess moisture outside of your home. It is of particular importance during periods of heavy heating or cooling.

As air is heated or cooled inside your HVAC system, humidity is released. This humidity eventually turns into condensation which must have somewhere to go. Enter: the condensate line. Your condensate line is essentially a drain line. It's typically made out of plastic (commonly PVC) or sometimes metal, although plastic is preferable. It connects directly to the HVAC unit then leads outdoors, often through an exterior wall. Its job is to efficiently funnel condensation away from your HVAC unit; sometimes a small pump is

attached to the HVAC system to expedite the process, but most condensate lines utilize gravity

- Machine hanging & copper piping: supporting is structure used to hang the indoor cassette and branch header and other machine components. Two cooper pipelines are used one is gas line and other is liquid line, which is connected between outdoor and indoor units. The pipes have varying cross-section which is gradually decreasing from outdoor unit to indoor unit
- Wiring:
- Leak detection: Due to refrigerant leakage, the running time of the system increases continuously. Both suction as well as discharge pressures reduce due to loss of refrigerant. There will be less liquid and more flash gas, which has negative effect on several components of the system.

Following are different method of refrigerant leakage detection:

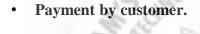
Visual Inspection, Soap Water Detection, Water Immersion Method, Halide Torch, Dye Interception Method, Electronic Leak Detection, Ultrasonic Leak Detection, Fluorescent Leak Detection, Nitrogen Water Detection, Gas Pressure Detection

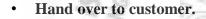
- Insulation: After determining that there are no leaks in the refrigerant pipes are insulated. Insulation is done around the entire surface of each pipe, including the refrigerant pipes from the indoor unit to the service valves inside the outdoor unit, the branch joints, distribution header, and connection points on each pipe.
- Vacuum: In a refrigerant system, only the refrigerant and oil should be circulating. During servicing or after many years of operation, the air may enter the system. The air from the atmosphere that enters the system include oxygen, nitrogen and moisture. These unwanted components will cause Rise in head pressure, Acids are produced in the refrigerant causing electroplating and damage to the motor insulation, Sludge is formed by a combination of oil, acid and moisture in the system

In order to remove all the unwanted moisture and gases from the refrigerant system, a state of near vacuum has to be achieved in which the pressure in the system is forced to go below the atmospheric pressure Commissioning & Testing

• Commissioning and testing: The commissioning process of any installation is critical as it provides official certification and confirmation that a piece of equipment is performing as it should. For our VRF systems, the commissioning process begins with a pressure test using nitrogen to find leaks, testing the system at a certain level. It is kept in this condition for a minimum of 24 hours to ensure it can maintain the same pressure level before the nitrogen is allowed to die out. This first section consists of three elements – a leak test, a pressure test and a strength test.

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CHAPTER 5

5. Theory of VRF System

5.1 Introduction of Air-conditioning System

Air conditioning (often referred to as AC. A/C, or air con) is the process of removing heat and moisture from the interior of an occupied space, to improve the comfort of occupants. Air conditioning can be used in both domestic and commercial environments. This process is most commonly used to achieve a more comfortable interior environment, typically for humans and other animals; however, air conditioning is also used to cool/dehumidify rooms filled with heat-producing electronic devices, such as computer servers, power amplifiers, and even to display and store some delicate products, such as artwork

Air conditioners often use a fan to distribute the conditioned air to an occupied space such as a building or a car to improve thermal comfort and indoor air quality.

Electric refrigerant-based AC units range from small units that can cool a small bed-room, which can be carried by a single adult, to massive units installed on the roof of office towers that can cool an entire building. The cooling is typically achieved through a refrigeration cycle, but sometimes evaporation or free cooling is used. Air conditioning systems can also be made based on desiccants (chemicals which re move moisture from the air). Some AC systems reject or store heat in subterranean pipes.

In the most general sense, air conditioning can refer to any form of technology that modifies the condition of air (heating, (de-) humidification, cooling, cleaning, ventilation, or air movement). In common usage, though. "air conditioning" refers to systems which cool air. In construction, a complete system of heating, ventilation, and air conditioning is referred to as HVAC.

5.2 what is VRF system

Variable Refrigerant Flow (VRF) system is an air conditioning system which uses refrigerant as a medium to provide zonal cooling and heating. It varies the flow of refrigerant to each room as per the required condition, the compressor used is driven by inverter so that by changing the speed of compressor the flow of refrigerant can be varied hence, the variable flow system. This ability to control the flow of refrigerant makes the VRF system ideal for applications with varying load or where zonal heating and cooling is desired. VRF systems provide design flexibility, energy savings, and cost-effective installation along with superior comfort.

5.3 Types of VRF system

5.3.1. Heat Pumps system – 2 pipes

VRF heat pump systems commonly known as 2 pipes, permit heating or cooling in all of the indoor units but NOT simultaneous heating and cooling. When the indoor units are in the cooling mode, they act as evaporators; when they are in the heating mode, they act as condensers.



Figure 5-1. Cooling from Outdoor Unit to Different Section

VRF heat pump systems are effectively applied in open plan areas, retail stores, cellular offices and any other area that require cooling or heating during the same operational periods.

5.3.2. Heat Recovery System- 3 pipe

Variable refrigerant flow systems with heat recovery (VRF-HR) capability can operate simultaneously in heating and/or cooling mode, enabling heat to be used rather than rejected as it would be in traditional heat pump systems. Each indoor unit is branched off from the 3 pipes using solenoid box which contains a series of valves. An indoor unit requiring cooling will open its liquid line and suction line valves and act as an evaporator. An indoor unit requiring heating will open its hot gas and liquid line valves and will act as a condenser. Typically, extra heat exchangers in distribution boxes are used to transfer some reject heat from the superheated refrigerant exiting the zone being cooled to the refrigerant that is going to the zone to be heated. This balancing act has the potential to produce significant energy savings. Three pipe heat pump systems are effectively applied in open plan areas, retail stores, cellular offices and any other area that require cooling and heating at the same time.



Figure 5-2. Heating and Cooling at Different Section from Outdoor Unit

5.3.3. VRF Water Cooled

Most commonly used are air-cooled systems, using packaged outdoor condensing units, which via refrigeration pipework connect to a number of indoor units. There are however some limitations, pipework runs, mainly vertical risers (although Samsung can have a vertical rise up to 115mtere), plant space and noise. Where these become an issue then water-cooled systems can be used. They operate as the Air-cooled units, but instead of having a built-in air-cooled heat exchanger they utilise and plate heat exchanger, which transfers the energy into a water loop.



Figure 5-3.VRF Water Cooling

This is connected to a cooling tower or dry cooler which transfers the energy/ heat to atmosphere. Due to this process the water cooled VRF systems can be placed internally with no worry about the vertical risers, in much smaller areas, taking up less space and can be attenuated to meet most environmental requirements. These systems are also ideal for building served by an existing landlords condenser water loop

5.4 Components of VRF system

5.4.1 Outdoor unit:

In a VRF system, multiple indoor fan coil units may be connected to one outdoor unit. The outdoor unit has one or more compressors that are inverter driven, so their speed can be varied by changing the frequency of the power supply to the compressor. As the compressor speed changes, so does the amount of refrigerant deliver by the compressor.

Types of outdoor unit:

- Top Discharge ODU.
- Side Discharge ODU.
- Higher Efficiency ODU.
- Medium Normal Range ODU.



Figure 5-4.Outdoor Unit

5.4.2. Indoor unit

The indoor unit of the split air conditioner is a box type housing in which all the important parts of the air conditioner are enclosed. The most common type of the indoor unit is the wall mounted type though other types like ceiling mounted and floor mounted are also used. An indoor unit containing the evaporator coil and blower. Split-system central air conditioning is most popular

type of residential heating and air-conditioning. The indoor unit is often connected to a furnace or heat pump.



Figure 5-5.Indoor Unit

Types of indoor units

1. **4-way cassette type** - Extremely quite operation By employing a super-high-stream turbo fan (three- dimensional twisted wing large bore and high efficiency), the wind flow of efficiency has been improved with the under damping slit mounted near the center of the revolving shaft, the abnormal noise which is unique to DC motors caused by the number of magnetic poles and revolution speed of the motor, is reduced, With broad range of air supply, is suitable to be used



Figure 5-6. 4-way cassette

2. **Compact 4-way cassette type** - Installing the Mini 4 Way Cassette is easy. This compact air conditioning unit can fit into one standard ceiling tile measuring 600 W x 600 D, meaning that alterations are unnecessary. With no extra construction work to carry out, set-up time is reduced, as is the subsequent financial impact on businesses.



Figure 5-7. Compact 4-way cassette

3. **2-way cassette type-** The two-way cassette discharges in two directions. The two way is ceiling mounted and includes its own filter system. The ceiling-cassette indoor units in these duct-free split heat-pump systems provide comfort in large, open spaces. Oneway air-flow ceiling-cassette indoor units.

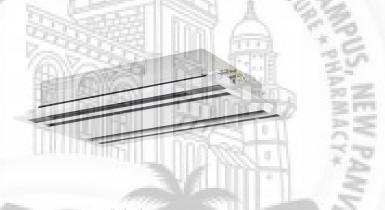


Figure 5-8. 2-way cassette

4. **1-way cassette type-** At a height of only 135mm, the Slim 1Way Cassette is the world's thinnest indoor air-cooling unit. The compact, lightweight design makes installation and maintenance in your space easier than ever. These high-performing units are so subtle that they can easily blend into interiors of all types and styles.



Figure 5-9. 1-way cassette

5. **Concealed duct**, standard type- Type and size of outdoor units and indoor units, and input air flow and external static pressure (ESP) for *ducted* indoor ... Heating and Cooling Equipment *Standard* for Safety and bear the ... Ceiling-*Concealed Ducted* units are designed for air volume against ... Cooling range can be extended from 5°F down to -4°F



Figure 5-10. Concealed Duct Type

5.4.3 Raffinates (Y-joint):

Raffinates is usually called as Y-joint. Which is used to branching the pipes from outdoor unit to indoor unit. It is made up of copper with insulation cover which may protect the leakage of refringent. It is available in many sizes as per the requirement.

This joint is mainly placed between the indoor AC units & branch to the others. It is always placed parallel to the surface in order to prevent pressure loss.



Figure 5-11. Raffinates (Y-joints)

5.4.4 Copper Pipes:

Copper tubing is most often used for the supply of hot and cold tap water, and as a refrigerant line in HVAC systems. There are two basic types of copper tubing, soft copper and hard copper. Copper tubing is joined using flare connection, compression connection, or solder.

1. Soft Drawn Copper Tubes Coils, Pipes:

Soft drawn, annealed, bending type copper tubes, coils, pipe for various gauge, length, size, surface finish with high quality. Suitable for VRF, VRV, Air-conditioner, Chiller applications.



Figure 5-12. Soft Drawn copper pipe

2. Hard Drawn Copper Pipes:

These type of copper tubes are rigid, hard and stiff. It is not easy to bent and should not be bent. There are three standard weight with different wall thickness for each type. Type K has the thickest wall tubing followed by Type L and Type M.

Type L outer diameters typically starts from 3/8 inch followed by 1/2-inch, 5/8-inch, 3/4-inch, 7/8-inch, 11/8-inch, 13/8-inch, 15/8-inch, 21/8 inch and 25/8 inch.

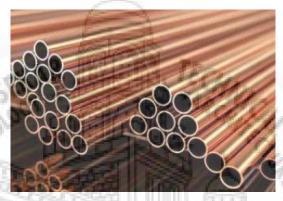


Figure 5-13. Hard Drawn Copper Pipes

5.4.5 Insulation:

Insulation is to prevent heat transfer between refrigerant and surrounding air. Under cooling mode of VRF system, the optimum insulation thickness varies between 7 and 8 mm for pipe sections of low-pressure gas pipeline and low-pressure liquid pipeline.



Figure 5-14.Insulation

CHAPTER 6

6. HEAT LOAD CALCULATION

6.1 Method of heat load estimation

• Step One

Calculate the area in square feet of the space to be cooled,

• Step Two

Calculate CFM ventilation

CFM ventilation= (area x height x no of air change)/60

CFM person= (no person x CFM/person)

Select the higher of the two as CFM ventilation for calculation

• Step three

Find difference in DB temperature as well as GR/LB of inside and outside

By referring ISHRAE handbook and psychometric chart

• Step four

Calculate sun heat gain

Solar gain through glass (BTU) = area x temp difference x factor (BTU)

Other transmission gain (BTU) = area x temp difference x factor (BTU)

Bypass outside air sensible load (BTU) = CFM ventilation x 0.08 x 1.08 x temperature difference

get factor from ISHRAE handbook table 12

Step five

Calculate internal sensible heat (BTU)

heat generated by occupants (BTU) = number of people $\times 245$

Heat generated by appliances (BTU) = total equipment watts x = 3.4

Heat generated by lights = (BTU) total equipment watts x 3.4

Total heat load (BTU) = solar gain through glass (BTU)+ other transmission gain (BTU)+ bypass outside air sensible load (BTU)+ internal sensible heat (BTU)

Leak loss (BTU) = 5% total heat load

Safety factor (BTU) = 5% total heat load

Total room sensible heat = Total heat load (BTU)+ Leak loss (BTU) + Safety factor (BTU)

• Step Six

Calculate outside air latent load (BTU) = CFM ventilation x G difference x bypass factor x 0.68

Internal latent heat (BTU) =no of people x factor

Get factor from ISHRAE handbook table 12

Subtotal (BTU) = outside air latent load (BTU) + Internal latent heat (BTU)

Safety factor (BTU) = 5% sub total

Total room latent heat = Subtotal(BTU) + Safety factor(BTU)

Room total heat = Total room sensible heat+ Total room latent heat

• Step seven

Outside air heat = CFM ventilation x G. Difference x (1-B.F.) x factor

Heat gain safety @ 3% = 3% Room total heat

Grand total heat (BTU) = Room total heat+ Outside air heat+ Heat gain safety @ 3%

Grand total heat (TONS) = Grand total heat (BTU)/12000

• Step eight

Sensible heat factor = Total room sensible heat/ Room total heat

Selected ADP= (ISHRAE table 15)

Dehumidified rise = (1-B.F.) (Temp difference – ADP)

Dehumidified air CFM = Total room sensible heat/ (1.08 x Dehumidified rise)

Tons as per CFM = Dehumidified air CFM/400

• Step nine

Check results

Grand total heat (BTU/HR/SQFT) = Grand total heat/area

Room sensible heat (BTU/HR/SQFT) = Room sensible heat/area

SQFT/ person = area/no of person

TONS/person = Grand total heat (TONS)/ no of person

Dehumidified CFM/ TONS = Dehumidified air CFM/ Grand total heat (TONS)

Area/TONS = area/Grand total heat (TONS)

6.2 Heat load estimation

The heat load for each room on the office floor is calculated using the method as shown above an is displayed in the tables below

DESIGN CONDITION, DESIGN DETAIL:

Design location:

- Location: Office building, sector-16, Vashi, Navi Mumbai, Maharashtra 400703.

- Latitude: 18.54° North.

Design Data:

SR.	NAME	AREA	HEIGHT	LIQHTING	NO. OF	CFM/VENTILATION
NO.	OF	(SQFT)	(FOOT)	(W/SQFT)	AIR	
	ROOM	100			CHANGE	
1.	STAFF	1400	11	1.5	2	513
	AREA-1	WAL		- 2.7	α/ρ	
2.	DCIT-1	200	11	1.5	2	73
3.	DCIT-2	200	11	1.5	2	73
4.	ITO-1	190	11	1.5	2	70
5.	ITO-2	190	11	1.5	2	70
6.	ITO-3	190	11	1.5	2	70
7.	ITO-4	190	11	1.5	2	70
8.	STAFF	1200	11	1.5	2	440
	AREA-2					
9.	CIT A	270	11	1.5	2	99
10.	AO AND	240	11	1.5	2	88
	PS (A)					

11.	JCTI-1	290	11	1.5	2	106
12.	ADDL	270	11	1.5	2	99
	JCTI-1					
13.	CIT (B)	270	11	1.5	2	99
14.	AO AND	210	11	1.5	2	77
	PS (B)					

Table 2. CFM/Ventilation Calculation on the Basis of Area

Calculate CFM ventilation:

CFM Ventilation= (Area×Height of the area×Lighting×No.of air change) 60

Where,

CFM= Air flow in cubic feet per minute

	- Table 1 - Table 1			Taring the second secon
SR	NAME OF ROOM	CFM /PERSON	NO. OF PERSON	CFM/VENTILATION
NO.	52			* 6
1.	STAFF AREA-1	10	30	300
2.	DCIT-1	10	07	70
3.	DCIT-2	10	07	70
4.	ITO-1	10	06	60
5.	ITO-2	10	06	60
6.	ITO-3	10	06	60
7.	ITO-4	10	06	60
8.	STAFF AREA-2	10	30	300
9.	CIT A	10	10	100
10.	AO AND PS (A)	10	06	60
11.	JCTI-1	10	10	100
12.	ADDL JCTI-1	10	10	100
13.	CIT (B)	10	10	100
14.	AO AND PS (B)	10	02	20

Table 3.CFM/Ventilation Calculation on the Basis of No. of Persons

CFM Ventilation= CFM/person \times No. of person

❖ Design Condition:

PARAMETER	D.B.(F°)	W.B.(F°)	%RH	GR/LB
OUTSIDE	100	83	60	146
INSIDE	75	-	50	64
DIFFERENCE	25	Α.	-	82

Table 4.Design Condition

6.2.1 STAFF AREA-1

SOLAR GAIN- GLASS						
DIRECTION	AREA	T.DIFF.	FACTOR	BTU		
NORTH	0	11	0.56	0		
SOUTH	0	11	0.56	0		
EAST	19	11	0.56	117		
WEST	0	165	0.56	0		
N-E	0	11	0.56	0		
N-W	0	118 –	0.56	0		
S-E	0	11	0.56	0		
S-W	0	113	0.56	0		

SOLAR & TRANSMISSION GAIN -WALL					
NORTH	0	20	0.34	0	
SOUTH	0	36	0.34	0	
EAST	52	22	0.34	390	
WEST	363	36	0.34	4443	
N-E	0	17	0.34	0	
N-W	0	13	0.34	0	
S-E	0	25	0.34	0	
S-W	0	21	0.34	0	
ROOF	1400	51	0.15	0	

OTHER TRANSMISSION GAIN				
AGLS	19	25	1.13	537

PART	1023	20	0.34	6956
CEIL	1400	20	0.34	9520
FLOR	1400	20	0.34	9520

BYPASS O.A. SENSIBLE LOAD				
CFMT.DIFF.BYPASSFACTORBTU				BTU
513	25	0.08	1.08	1108

INTERNAL SENSIBLE LOAD					
PEOPLE	30	245	A TON	7350	
APPL.	5000	3.4		17000	
LIGHTS	2100	3.4	1.25	8925	
FOOD	0	60	作者/ 遺	0	
SUB TOTAL	65866				

LEAK LOSS +SAFETY FACTOR=5%	3293
ROOM SENSIBLE HEAT	72452

BYPASS OUTSIDE AIR LATENT LOAD						
<u>CFM</u>	G. DIFF	BYPASS	FACTOR	<u>BTU</u>		
513	82	0.08	0.68	2288		

INTERNAL L	ATENT LOAI	D	The second
PEOPLE	30	205	6150

SUB TOTAL	8438
SAFETY FACTOR=5%	422
ROOM LATENT HEAT	8860
ROOM TOTAL HEAT	81312

OUTSIDE AIR HEA	AT				
	<u>CFM</u>	G. DIFF	<u>1-B.F.</u>	FACTOR	<u>BTU</u>
SENSIBLE	513	25	0.92	1.08	12743

LATENT	513	82	0.9	02	0.68	26316
SUB TOTAL						39059
TOTAL						120371
HEAT GAIN SAFE	TY FA	CTOR @ 39	6			3611
GRAND TOTAL H	EAT			(TONS)	10.3	123982

SENSIBLE HEAT FACTOR	0.89
SELECTED A.D.P.	54
DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	3354
TONS AS PER Cfm	8.38
CHAMILTIN MANSO	ECHA.

GRAND TOTAL HEAT (BTU/HR/SQFT.)	92
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	51.75
SQFT/PERSON	46.67
TONS PER SQFT	0.01
CFM PER SQFT	2.39
TONS/PERSON	0.34
DEHUMIDIFIED CFM/TON	325.63
AREA PER TON	135.92

Table 5.Calculation of staff Area-1

6.2.2. DCIT-1

SOLAR GAIN-GLASS						
DIRECTION	AREA	T.DIFF.	FACTOR	BTU		
NORTH	0	11	0.56	0		
SOUTH	0	11	0.56	0		
EAST	0	11	0.56	0		
WEST	0	165	0.56	0		
N-E	0	11	0.56	0		
N-W	0	118	0.56	0		
S-E	0	11	0.56	0		
S-W	0	113	0.56	0		

SOLAR & TRANSMISSION GAIN -WALL					
NORTH	0	20	0.34	0	
SOUTH	0	36	0.34	0	
EAST	0	22	0.34	0	
WEST	0	36	0.34	0	
N-E	0	17	0.34	0	
N-W	0	13	0.34	0	
S-E	0	25	0.34	0	
S-W	0	21	0.34	0	
ROOF	200	51	0.15×0	0	

OTHER TR	ANSMISSIO	ON GAIN	100000	N. T.
AGLS	0	25	1.13	0
PART	176	20	0.34	1197
CEIL	200	20	0.34	1360
FLOR	200	20	0.34	1360

BYPASS O.A. SENSIBLE LOAD						
<u>C</u>	FM	T.DIFF.	BYPASS	FACTOR	BTU	
73		25	0.08	1.08	158	

INTERNAL SENSIBLE LOAD						
PEOPLE	7	245	-3	1715		
APPL.	250	3.4	1000	850		
LIGHTS	300	3.4	1.25	1275		
FOOD	0	60		0		
SUB TOTAL	SUB TOTAL					

LEAK LOSS +SAFETY FACTOR=5%	396
ROOM SENSIBLE HEAT	8707

BYPASS OUTSIDE AIR LATENT LOAD					
CFMG. DIFFBYPASSFACTORBTU					
73 82 0.08 0.68 326					

.

INTERNAL LATENT LOAD				
PEOPLE	7	205	1435	

SUB TOTAL	1761
SAFETY FACTOR=5%	88
ROOM LATENT HEAT	1849
ROOM TOTAL HEAT	10556

OUTSIDE AIR HEAT					
	<u>CFM</u>	G. DIFF	1-B.F.	<u>FACTOR</u>	BTU
SENSIBLE	73	25	0.92	1.08	1813
LATENT	73	82	0.92	0.68	3745
SUB TOTAL	1900	岛		B 7	5558
TOTAL	line.			1 1	16114
HEAT GAIN SAFETY FACTOR @ 3%			1 168	3/4	483
GRAND TOTAL HEAT			(TONS)	1.38	16597

SENSIBLE HEAT FACTOR	0.82
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	403
TONS AS PER Cfm	1.0

GRAND TOTAL HEAT (BTU/HR/SQFT.)	82.98
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	43.53
SQFT/PERSON	28.57
TONS PER SQFT	0.01
CFM PER SQFT	2.01
TONS/PERSON	0.19
DEHUMIDIFIED CFM/TON	292.10
AREA PER TON	144.92

Table 6.Calculation of DCIT-1

6.2.3. DCIT-2

❖ SENSIBLE HEAT GAIN:

SOLAR GAIN-GLASS				
DIRECTION	AREA	T.DIFF.	FACTOR	BTU
NORTH	0	11	0.56	0
SOUTH	0	11	0.56	0
EAST	0	11	0.56	0
WEST	0	165	0.56	0
N-E	0	11	0.56	0
N-W	0	118	0.56	0
S-E	0	11	0.56	0
S-W	0	113	0.56	0

SOLAR & TRANSMISSION GAIN -WALL					
NORTH	0	20	0.34	0	
SOUTH	0	36	0.34	0	
EAST	0	22	0.34	0	
WEST	0	36	0.34	0	
N-E	0	17	0.34	0	
N-W	0	13	0.34	0	
S-E	0	25	0.34	0	
S-W	0	21	0.34	0	
ROOF	200	51	0.15×0	0	

OTHER TRANSMISSION GAIN				
AGLS	0	25	1.13	0
PART	176	20	0.34	1197
CEIL	200	20	0.34	1360
FLOR	200	20	0.34	1360

BYPASS O.A. SENSIBLE LOAD					
CFMT.DIFF.BYPASSFACTORBTU					
73 25 0.08 1.08 158					

INTERNAL SENSIBLE LOAD

PEOPLE	7	245		1715
APPL.	250	3.4		850
LIGHTS	300	3.4	1.25	1275
FOOD	0	60		0
SUB TOTAL	7915			

LEAK LOSS +SAFETY FACTOR=5%	396
ROOM SENSIBLE HEAT	8707

BYPASS OUTSIDE AIR LATENT LOAD					
CFM G. DIFF BYPASS FACTOR BTU					
73	82	0.08	0.68	326	

INTERNAL LA	TENT LOA	D	
PEOPLE	7 7	205	1435
		TO THE STATE OF	

SUB TOTAL	1761
SAFETY FACTOR=5%	88
ROOM LATENT HEAT	1849
ROOM TOTAL HEAT	10556

OUTSIDE AIR HEAT					
	CFM	G. DIFF	<u>1-B.F.</u>	FACTOR	BTU
SENSIBLE	73	25	0.92	1.08	1813
LATENT	73	82	0.92	0.68	3745
SUB TOTAL		. mun	IBAI		5558
TOTAL					16114
HEAT GAIN SAFETY FACTOR @ 3%					483
GRAND TOTAL H	GRAND TOTAL HEAT			1.38	16597

SENSIBLE HEAT FACTOR	0.82
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20

DEHUMIDIFIED AIR Cfm	403
TONS AS PER Cfm	1.0

GRAND TOTAL HEAT (BTU/HR/SQFT.)	82.98
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	43.53
SQFT/PERSON	28.57
TONS PER SQFT	0.01
CFM PER SQFT	2.01
TONS/PERSON	0.19
DEHUMIDIFIED CFM/TON	292.10
AREA PER TON	144.92

Table 7. Calculation of DCIT-2

6.2.4. ITO - 1

SENSIBLE HEAT GAIN: SUN GAIN:

SOLAR GAIN- SOLAR					
DIRTECTION	AREA	T.DIFF.	FACTOR	BTU	
NORTH	44	11	0.56	271	
SOUTH	0	11	0.56	0	
EAST	0	11	0.56	0	
WEST	0	165	0.56	0	
N-E	0	11	0.56	0	
N-W	0	118	0.56	0	
S-E	0	11	0.56	0	
S-W	0	113	0.56	0	

SOLAR & TRANSMISSION GAIN -WALL					
NORTH	78	20	0.34	530	
SOUTH	0	36	0.34	0	
EAST	0	22	0.34	0	
WEST	0	36	0.34	0	
N-E	0	17	0.34	0	
N-W	0	13	0.34	0	
S-E	0	25	0.34	0	
S-W	0	21	0.34	0	

ROOF 190 51 0.	.15×0 0
----------------	---------

OTHER TRANSMISSION GAIN					
AGLS 44 25 1.13 1243					
PART	369	20	0.34	2509	
CEIL	190	20	0.34	1292	
FLOR	190	20	0.34	1292	

BYPASS O.A. SENSIBLE LOAD						
CFM T.DIFF. BYPASS FACTOR BTU						
70	25	0.08	1.08	151		

INTERNAL SENSIBLE LOAD						
PEOPLE	6	245	E CLIE	1470		
APPL.	250	3.4	OF SECTION	850		
LIGHTS	285	3.4	1.25	1211		
FOOD	0	60	250	0		
SUB TOTAL	10819					

LEAK LOSS +SAFETY FACTOR=5%	541
ROOM SENSIBLE HEAT	11901

BYPASS OUTSIDE AIR LATENT LOAD						
CFM G. DIFF BYPASS FACTOR BTU						
70	82	0.08	0.68	312		

INTERNAL LATENT LOAD
PEOPLE 6 205 1230

SUB TOTAL	1542
SAFETY FACTOR=5%	77
ROOM LATENT HEAT	1619
ROOM TOTAL HEAT	13520

❖ GRAND TOTAL HEAT:

OUTSIDE AIR HEAT						
	<u>CFM</u>	G. DIFF	<u>1-B.F.</u>	FACTOR	<u>BTU</u>	
SENSIBLE	70	25	0.92	1.08	1739	
LATENT	70	82	0.92	0.68	3591	
SUB TOTAL		5330				
TOTAL		18850				
HEAT GAIN SAFE	CTOR @	J.B		566		
3%						
GRAND TOTAL H	O TOTAL HEAT			1.6	19416	

SENSIBLE HEAT FACTOR	0.88
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	550
TONS AS PER Cfm	1.37

GRAND TOTAL HEAT (BTU/HR/SQFT.)	102.18
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	62.63
SQFT/PERSON	31.67
TONS PER SQFT	0.01
CFM PER SQFT	2.89
TONS/PERSON	0.27
DEHUMIDIFIED CFM/TON	343.75
AREA PER TON	118.75

Table 8. Calculation of ITO-1

6.2.5, ITO- 2

SENSIBLE HEAT GAIN: SUN GAIN:

SOLAR GAIN- GLASS						
DIRECTION	AREA	T.DIFF.	FACTOR	BTU		
NORTH	42	11	0.56	259		
SOUTH	0	11	0.56	0		
EAST	0	11	0.56	0		
WEST	0	165	0.56	0		

N-E	0	11	0.56	0
N-W	0	118	0.56	0
S-E	0	11	0.56	0
S-W	0	113	0.56	0

SOLAR & TRANSMISSION GAIN -WALL						
NORTH	81	20	0.34	551		
SOUTH	0	36	0.34	0		
EAST	0	22	0.34	0		
WEST	0	36	0.34	0		
N-E	0	17	0.34	0		
N-W	0	13	0.34	0		
S-E	0	25	0.34	0		
S-W	0	21	0.34	0		
ROOF	190	51	0.15×0	0		

OTHER TRANSMISSION GAIN					
AGLS	42	25	1.13	1187	
PART	184	20	0.34	1251	
CEIL	190	20	0.34	1292	
FLOR	190	20	0.34×0	0	

BYPASS O.A. SENSIBLE LOAD						
CFM T.DIFF. BYPASS FACTOR BTU						
70	25	0.08	1.08	151		

INTERNAL SENSIBLE LOAD					
PEOPLE	6	245		1470	
APPL.	250	3.4	UMRA	850	
LIGHTS	285	3.4	1.25	1211	
FOOD	0	60		0	
SUB TOTAL	8222				

LEAK LOSS +SAFETY FACTOR=5%	411
ROOM SENSIBLE HEAT	9044

BYPASS OUTSIDE AIR LATENT LOAD					
CFM G. DIFF BYPASS FACTOR BTU					
70 82 0.08 0.68 312					

INTERNAL LATENT LOAD					
PEOPLE	6	205	1230		

SUB TOTAL	1542
SAFETY FACTOR=5%	77
ROOM LATENT HEAT	1619
ROOM TOTAL HEAT	10663

OUTSIDE AIR HEAT					
50	<u>CFM</u>	G. DIFF	<u>1-B.F.</u>	FACTOR	<u>BTU</u>
SENSIBLE	70	25	0.92	1.08	1739
LATENT	70	82	0.92	0.68	3590
SUB TOTAL				THINT	5329
TOTAL	15		16	7724	15992
HEAT GAIN SAFETY FACTOR @ 3%				1 1888 I	480
GRAND TOTAL HEAT			(TONS)	1.4	16472

SENSIBLE HEAT FACTOR	0.84
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	418
TONS AS PER Cfm	1.04

	The state of the s
GRAND TOTAL HEAT (BTU/HR/SQFT.)	86.69
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	47.6
SQFT/PERSON	31.67
TONS PER SQFT	0.01
CFM PER SQFT	2.2
TONS/PERSON	0.23
DEHUMIDIFIED CFM/TON	299
AREA PER TON	135.71

Table 9.Calculation of ITO-2

6.2.6. ITO- 3:

SOLAR GAIN- GLASS					
DIRECTION	AREA	T.DIFF.	FACTOR	BTU	
NORTH	39	11	0.56	240	
SOUTH	0	11	0.56	0	
EAST	57	11	0.56	351	
WEST	0	165	0.56	0	
N-E	0	11	0.56	0	
N-W	0	118	0.56	0	
S-E	0	11	0.56	0	
S-W	0	113	0.56	0	

SOLAR & TRANSMISSION GAIN -WALL						
NORTH	81	20	0.34	551		
SOUTH	0	36	0.34	0		
EAST	0	22	0.34	0		
WEST	0	36	0.34	0		
N-E	0	17	0.34	0		
N-W	0	13	0.34	0		
S-E	0	25	0.34	0		
S-W	0	21	0.34	0		
ROOF	1400	51	0.15×0	0		

OTHER TRANSMISSION GAIN					
AGLS	96	25	1.13	2712	
PART	184	20	0.34	1251	
CEIL	190	20	0.34	1292	
FLOR	190	20	0.34×0	0	

BYPASS O.A. SENSIBLE LOAD					
CFMT.DIFF.BYPASSFACTORBTU					
70 25 0.08 1.08 151					

INTERNAL SENSIBLE LOAD					
PEOPLE	6	245		1470	
APPL.	250	3.4		850	
LIGHTS	285	3.4	1.25	1211	
FOOD	0	60		0	
SUB TOTAL				10079	

LEAK LOSS +SAFETY FACTOR=5%	504
ROOM SENSIBLE HEAT	11087

BYPASS OUTSIDE AIR LATENT LOAD					
CFM G. DIFF BYPASS FACTOR BTU					
70	82	0.08	0.68	312	

INTERNAL LA	TENT LOA	D	行工
PEOPLE	6	205	1230
- 22	i ii		

SUB TOTAL	1542
SAFETY FACTOR=5%	77
ROOM LATENT HEAT	1619
ROOM TOTAL HEAT	12706

OUTSIDE AIR HEAT						
	<u>CFM</u>	G. DIFF	<u>1-I</u>	3.F.	FACTOR	BTU
SENSIBLE	70	25	0.9)2	1.08	1739
LATENT	70	82	0.9	2	0.68	3591
SUB TOTAL	5330					
TOTAL	18036					
HEAT GAIN SAFETY FACTOR @ 3% 54					541	
GRAND TOTAL H	OTAL HEAT			(TONS)	1.5	18577

SENSIBLE HEAT FACTOR	0.87
SELECTED A.D.P.	52

DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	513
TONS AS PER Cfm	1.3

GRAND TOTAL HEAT (BTU/HR/SQFT.)	97.77
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	58.35
SQFT/PERSON	31.67
TONS PER SQFT	0.01
CFM PER SQFT	2.7
TONS/PERSON	0.25
DEHUMIDIFIED CFM/TON	342
AREA PER TON	125.60

Table 10.Calculation of ITO-3

6.2.7. ITO-4:

SOLAR GAIN	- GLASS	AME 49	55016	52 50
DIRECTION	AREA	T.DIFF.	FACTOR	BTU
NORTH	39	11	0.56	240
SOUTH	0	11	0.56	0
EAST	32	11	0.56	197
WEST	0	165	0.56	0
N-E	0	11	0.56	0
N-W	0	118	0.56	0
S-E	0	11	0.56	0
S-W	0	113	0.56	0

SOLAR & TRANSMISSION GAIN -WALL						
NORTH	92	20	0.34	626		
SOUTH	0	36	0.34	0		
EAST	160	22	0.34	1197		
WEST	363	36	0.34	0		
N-E	0	17	0.34	0		
N-W	0	13	0.34	0		
S-E	0	25	0.34	0		
S-W	0	21	0.34	0		

ROOF 1400	51	0.15	0
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OTHER TRANSMISSION GAIN					
AGLS	71	25	1.13	2006	
PART	0	20	0.34	0	
CEIL	190	20	0.34	1292	
FLOR	190	20	0.34	1292	

BYPASS O.A. S	SENSIBLE	LOAD		
<u>CFM</u>	T.DIFF.	BYPASS	FACTOR	BTU
70	25	0.08	1.08	151

INTERNAL S	SENSIBLE	LOAD	7:11/7	10 1/2
PEOPLE	6	245	THE REAL PROPERTY.	1470
APPL.	250	3.4	STATE N	850
LIGHTS	285	3.4	1.25	1211
FOOD	0	60	55.05	0
SUB TOTAL		BIYE	Wat III	10532

LEAK LOSS +SAFETY FACTOR=5%	527
ROOM SENSIBLE HEAT	11586

BYPASS OUTSIDE AIR LATENT LOAD						
<u>CFM</u>	G. DIFF	BYPASS	FACTOR	<u>BTU</u>		
70	82	0.08	0.68	312		

INTERNAL LATENT LOAD
PEOPLE 6 205 1230

SUB TOTAL	1542
SAFETY FACTOR=5%	77
ROOM LATENT HEAT	1619
ROOM TOTAL HEAT	13205

❖ GRAND TOTAL HEAT:

OUTSIDE AIR HEAT							
	<u>CFM</u>	G. DIFF	<u>1-I</u>	3.F.	FACTOR	BTU	
SENSIBLE	70	25	0.9	02	1.08	1739	
LATENT	70	82	0.9	02	0.68	3591	
SUB TOTAL	5330						
TOTAL	18535						
HEAT GAIN SAFETY FACTOR @ 3% 556							
GRAND TOTAL H	EAT	1		(TONS)	1.6	19091	

SELECTED A.D.P.	52
DEHUMIDIFIED RISE	21
DEHUMIDIFIED AIR Cfm	511
TONS AS PER Cfm	1.27

GRAND TOTAL HEAT (BTU/HR/SQFT.)	100.47
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	61
SQFT/PERSON	31.67
TONS PER SQFT	0.01
CFM PER SQFT	2.68
TONS/PERSON	0.26
DEHUMIDIFIED CFM/TON	319.37
AREA PER TON	118.75

Table 11. Calculation of ITO-4

6.2.8. STAFF AREA-2:

SOLAR GAIN- GLASS						
DIRECTION	AREA	T.DIFF.	FACTOR	BTU		
NORTH	141	11	0.56	869		
SOUTH	0	11	0.56	0		
EAST	0	11	0.56	0		
WEST	0	165	0.56	0		
N-E	0	11	0.56	0		

N-W	0	118	0.56	0
S-E	0	11	0.56	0
S-W	0	113	0.56	0

SOLAR & TRANSMISSION GAIN -WALL						
NORTH	112	20	0.34	762		
SOUTH	0	36	0.34	0		
EAST	0	22	0.34	0		
WEST	0	36	0.34	0		
N-E	0	17	0.34	0		
N-W	0	13	0.34	0		
S-E	0	25	0.34	0		
S-W	0	21	0.34	0		
ROOF	1200	51	0.15×0	0		

AGLS	141	25	1.13	3983
PART	1221	20	0.34	8303
CEIL	1200	20	0.34	8160
FLOR	1200	20	0.34	8160

BYPASS O.A. S	SENSIBLE	LOAD	The I	
<u>CFM</u>	T.DIFF.	BYPASS	FACTOR	BTU
440	25	0.08	1.08	1064

INTERNAL SE	NSIBLE :	LOAD		
PEOPLE	30	245		7350
APPL.	5000	3.4		17000
LIGHTS	1800	3.4	1.25	7650
FOOD	0	60		0
SUB TOTAL	63301			

LEAK LOSS +SAFETY FACTOR=5%	3165
ROOM SENSIBLE HEAT	69631

BYPASS OUTSIDE AIR LATENT LOAD						
CFM G. DIFF BYPASS FACTOR BTU						
440 82 0.08 0.68 1963						

INTERNAL LATENT LOAD					
PEOPLE	30	205	6150		

SUB TOTAL	8113
SAFETY FACTOR=5%	406
ROOM LATENT HEAT	8519
ROOM TOTAL HEAT	78150

OUTSIDE AIR HI	EAT		T-		5 4	16.Ca
SENSIBLE	440	25	0.9	92	1.08	10930
LATENT	440	82	0.9	92	0.68	22572
SUB TOTAL	7/	61W	335	71 BS		33502
TOTAL		331163	YEAR		3 100	111652
HEAT GAIN SAF	ETY FA	CTOR @	3%			3350
GRAND TOTAL	HEAT	HILL		(TONS)	9.58	115002
3.7		шш	ura	LIM	1000 1	1 3

SENSIBLE HEAT FACTOR	0.89
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	3224
TONS AS PER Cfm	8.06

GRAND TOTAL HEAT (BTU/HR/SQFT.)	95.83
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	58.02
SQFT/PERSON	40
TONS PER SQFT	0.01
CFM PER SQFT	2.68
TONS/PERSON	0.32
DEHUMIDIFIED CFM/TON	336.53
AREA PER TON	125.26

Table 12. Calculation of Staff Area-2

6.2.9. CIT-A:

SOLAR GAIN- GLASS					
DIRECTION	AREA	T.DIFF.	FACTOR	BTU	
NORTH	26	11	0.56	160	
SOUTH	0	11	0.56	0	
EAST	51	11	0.56	315	
WEST	0	165	0.56	0	
N-E	0	11	0.56	0	
N-W	0	118	0.56	0	
S-E	0	011	0.56	0	
S-W	0	113	0.56	0	

SOLAR & TRANSMISSION GAIN -WALL					
NORTH	130	20	0.34	884	
SOUTH	0	36	0.34	0	
EAST	181	22	0.34	1354	
WEST	0	36	0.34	0	
N-E	0	17	0.34	0	
N-W	0	13	0.34	0	
S-E	0	25	0.34	0	
S-W	0	21	0.34	0	
ROOF	270	51	0.15×0	0	

OTHER TRANSMISSION GAIN				
AGLS	77	25	1.13	2175
PART	147	20	0.34	1000
CEIL	270	20	0.34	1836
FLOR	270	20	0.34	1836

BYPASS O.A. SENSIBLE LOAD						
<u>CFM</u>	<u>FM T.DIFF. BYPASS FACTOR BTU</u>					
100	25 0.08 1.08 216					

INTERNAL SENSIBLE LOAD					
PEOPLE	10	245		2450	
APPL.	250	3.4		850	
LIGHTS	405	3.4	1.25	1721	
FOOD	0	60		0	
SUB TOTAL	14797				

LEAK LOSS +SAFETY FACTOR=5%	740
ROOM SENSIBLE HEAT	16277

BYPASS OUTSIDE AIR LATENT LOAD					
CFM G. DIFF BYPASS FACTOR BTU					
100	82	0.08	0.68	446	

INTERNAL LA	TENT LOAD		PT.	
PEOPLE	10	205	2050	
Times 1447		I FRIVEN	HULE	
1 22	HAI	1 1534 1835	Tri-United	₩

SUB TOTAL	2496
SAFETY FACTOR=5%	125
ROOM LATENT HEAT	2621
ROOM TOTAL HEAT	18898

OUTSIDE AIR HEAT						
	<u>CFM</u>	G. DIFF	<u>1</u> -I	3.F.	FACTOR	BTU
SENSIBLE	100	25	0.9	2	1.08	2484
LATENT	100	82	0.9	2	0.68	5130
SUB TOTAL		76				
TOTAL	26512					26512
HEAT GAIN SAFETY FACTOR @ 3% 795					795	
GRAND TOTAL H	O TOTAL HEAT (TONS) 2.3			27307		

SENSIBLE HEAT FACTOR	0.86
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20

DEHUMIDIFIED AIR Cfm	754
TONS AS PER Cfm	1.88

GRAND TOTAL HEAT (BTU/HR/SQFT.)	101.13
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	60.28
SQFT/PERSON	27
TONS PER SQFT	0.01
CFM PER SQFT	2.79
TONS/PERSON	0.23
DEHUMIDIFIED CFM/TON	327.82
AREA PER TON	117.39

Table 13. Calculation of CIT-A

6.2.10. AO & PS (A):

SOLAR GAIN	- GLASS	995		1
DIRECTION	AREA	T.DIFF.	FACTOR	BTU
NORTH	0	11	0.56	0
SOUTH	0	11 -	0.56	0
EAST	51	11	0.56	314
WEST	0	165	0.56	0
N-E	0	11	0.56	0
N-W	0	118	0.56	0
S-E	0	11	0.56	0
S-W	0	113	0.56	0

SOLAR & TRANSMISSION GAIN -WALL						
NORTH	0	20	0.34	0		
SOUTH	0	36	0.34	0		
EAST	153	22	0.34	1144		
WEST	0	36	0.34	0		
N-E	0	17	0.34	0		
N-W	0	13	0.34	0		
S-E	0	25	0.34	0		
S-W	0	21	0.34	0		
ROOF	240	51	0.15×0	0		

OTHER TRANSMISSION GAIN					
AGLS	51	25	1.13	1441	
PART	131	20	0.34	891	
CEIL	240	20	0.34	1632	
FLOR	240	20	0.34	1632	

BYPASS O.A. SENSIBLE LOAD						
<u>CFM</u> <u>T</u>	DIFF.	BYPASS	FACTOR	BTU		
88 2:	5	0.08	1.08	190		

PEOPLE	6	245	7.411	1470
APPL.	500	3.4		1700
LIGHTS	360	3.4	1.25	1530
FOOD	0	60		0
SUB TOTAL		A 190	3234	11944

LEAK LOSS +SAFETY FACTOR=5%	597
ROOM SENSIBLE HEAT	13138

BYPASS OUTSIDE AIR LATENT LOAD					
CFM G. DIFF BYPASS FACTOR BTU					
88	82	0.08	0.68	393	

INTERNAL LATE	NT LOAD	Barrer .	1010/b
PEOPLE	6	205	1230

SUB TOTAL	1623
SAFETY FACTOR=5%	81
ROOM LATENT HEAT	1704
ROOM TOTAL HEAT	14842

❖ GRAND TOTAL HEAT:

OUTSIDE AIR HEAT						
	<u>CFM</u>	G. DIFF	<u>1-I</u>	3.F.	FACTOR	BTU
SENSIBLE	88	25	0.9	2	1.08	2186
LATENT	88	82	0.9	2	0.68	4514
SUB TOTAL	6700					
TOTAL	21542					
HEAT GAIN SAFETY FACTOR @ 3% 646						646
GRAND TOTAL H	GRAND TOTAL HEAT			(TONS)	1.85	22188

SENSIBLE HEAT FACTOR	0.88
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	608
TONS AS PER Cfm	1.52

GRAND TOTAL HEAT (BTU/HR/SQFT.)	92.45
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	54.74
SQFT/PERSON	40
TONS PER SQFT	0.01
CFM PER SQFT	2.53
TONS/PERSON	0.30
DEHUMIDIFIED CFM/TON	328.64
AREA PER TON	129.72

Table 14.Calculation of AO&PO(A)

6.2.11. JCTI-1:

SOLAR GAIN-GLASS						
DIRECTION	AREA	T.DIFF.	FACTOR	BTU		
NORTH	0	11	0.56	0		
SOUTH	30	11	0.56	185		
EAST	51	11	0.56	314		
WEST	0	165	0.56	0		
N-E	0	11	0.56	0		
N-W	0	118	0.56	0		

S-E	0	11	0.56	0
S-W	0	113	0.56	0

SOLAR & TRANSMISSION GAIN -WALL					
NORTH	0	20	0.34	0	
SOUTH	161	36	0.34	1971	
EAST	144	22	0.34	1077	
WEST	0	36	0.34	0	
N-E	0	17	0.34	0	
N-W	0	13	0.34	0	
S-E	0	25	0.34	0	
S-W	0	21	0.34	0	
ROOF	200	51	0.15×0	0	

OTHER TRANSMISSION GAIN					
AGLS	82	25	1.13	2317	
PART	197	20	0.34	1340	
CEIL	290	20	0.34	1972	
FLOR	290	20	0.34	1972	

BYPASS O.A. S	SENSIBLE	LOAD		0.1156
<u>CFM</u>	T.DIFF.	BYPASS	FACTOR	BTU
106	25	0.08	1.08	229

INTERNAL SENSIBLE LOAD					
PEOPLE	10	245		2450	
APPL.	250	3.4		850	
LIGHTS	435	3.4	1.25	1849	
FOOD	0	60	MRAI	0	
SUB TOTAL	16526				

LEAK LOSS +SAFETY FACTOR=5%	826
ROOM SENSIBLE HEAT	18178

BYPASS OUTSIDE AIR LATENT LOAD					
<u>CFM</u>	G. DIFF	BYPASS	FACTOR	<u>BTU</u>	
106	82	0.08	0.68	473	

INTERNAL L	ATENT LOAD		
PEOPLE	10	205	2050

SUB TOTAL	2523
SAFETY FACTOR=5%	126
ROOM LATENT HEAT	2649
ROOM TOTAL HEAT	20827

OUTSIDE AIR HEAT					
200	<u>CFM</u>	G. DIFF	<u>1-B.F.</u>	FACTOR	BTU
SENSIBLE	106	25	0.92	1.08	2633
LATENT	106	82	0.92	0.68	5438
SUB TOTAL	76		911 688	13 5 X	8071
TOTAL	18	TANKA	THE	- Bull	28898
HEAT GAIN SAFETY FACTOR @ 3%					867
GRAND TOTAL HEAT			(TONS)	2.48	29765

SENSIBLE HEAT FACTOR	0.87
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	842
TONS AS PER Cfm	2.1

GRAND TOTAL HEAT (BTU/HR/SQFT.)	102.63
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	62.68
SQFT/PERSON	29
TONS PER SQFT	0.01
CFM PER SQFT	2.90
TONS/PERSON	0.24
DEHUMIDIFIED CFM/TON	339.51
AREA PER TON	116.93

Table 15.Calculation of JCIT-1

6.2.12. ADDL JCTI-1:

❖ SENSIBLE HEAT GAIN:

SOLAR GAIN-GLASS				
DIRECTION	AREA	T.DIFF.	FACTOR	BTU
NORTH	0	11	0.56	0
SOUTH	38	11	0.56	234
EAST	0	11	0.56	0
WEST	0	165	0.56	0
N-E	0	11	0.56	0
N-W	0	118	0.56	0
S-E	0	11	0.56	0
S-W	0	113	0.56	0

SOLAR & TRANSMISSION GAIN -WALL				
NORTH	0	20	0.34	0
SOUTH	126	36	0.34	1542
EAST	0	22	0.34	0
WEST	0	36	0.34	0
N-E	0	17	0.34	0
N-W	0	13	0.34	0
S-E	0	25	0.34	0
S-W	0	21	0.34	0
ROOF	270	51	0.15×0	0

OTHER TRANSMISSION GAIN				
AGLS	38	25	1.13	1074
PART	197	20	0.34	1340
CEIL	270	20	0.34	1836
FLOR	270	20	0.34	1836

BYPASS O.A. SENSIBLE LOAD					
<u>CFM</u>	T.DIFF.	BYPASS	FACTOR	BTU	
100	25	0.08	1.08	216	

INTERNAL SENSIBLE LOAD

PEOPLE	10	245		2450
APPL.	250	3.4		850
LIGHTS	405	3.4	1.25	1721
FOOD	0	60		0
SUB TOTAL	13109			

LEAK LOSS +SAFETY FACTOR=5%	655
ROOM SENSIBLE HEAT	14419

BYPASS OUTSIDE AIR LATENT LOAD				
CFM G. DIFF BYPASS FACTOR BTU				
100	82	0.08	0.68	446

INTERNAL LA	TENT LOAI	D	1889	1
PEOPLE	10	205	2050	7111

SUB TOTAL	2496
SAFETY FACTOR=5%	125
ROOM LATENT HEAT	2621
ROOM TOTAL HEAT	17040

OUTSIDE AIR HEAT					
- 0	<u>CFM</u>	G. DIFF	<u>1-B.F.</u>	FACTOR	<u>BTU</u>
SENSIBLE	100	25	0.92	1.08	2484
LATENT	100	82	0.92	0.68	5130
SUB TOTAL	.41	/ MIIIM	DAI -	IMDi.	7614
TOTAL		0141	DMI		24654
HEAT GAIN SAF	FETY FACTOR @ 3%			740	
GRAND TOTAL I	HEAT		(TONS)	2.1	25394

SENSIBLE HEAT FACTOR	0.84
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	668

GRAND TOTAL HEAT (BTU/HR/SQFT.)	94.05
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	53.40
SQFT/PERSON	27
TONS PER SQFT	0.01
CFM PER SQFT	2.47
TONS/PERSON	0.21
DEHUMIDIFIED CFM/TON	318.095
AREA PER TON	128.57

Table 16. Calculation of ADDL JCIT-1

6.2.13. CIT-B

SOLAR GAIN	-GLASS		555	111
DIRECTION	AREA	T.DIFF.	FACTOR	BTU
NORTH	0	11	0.56	0
SOUTH	34	11	0.56	209
EAST	0	11	0.56	0
WEST	0	165	0.56	0
N-E	0	11	0.56	0
N-W	0	118	0.56	0
S-E	0	11	0.56	0
S-W	0	113	0.56	0

SOLAR & TRANSMISSION GAIN -WALL					
NORTH	0	20	0.34	0	
SOUTH	153	36	0.34	1873	
EAST	0	22	0.34	0	
WEST	79	36	0.34	967	
N-E	0	17	0.34	0	
N-W	0	13	0.34	0	
S-E	0	25	0.34	0	
S-W	0	21	0.34	0	
ROOF	270	51	0.15×0	0	

OTHER TRANSMISSION GAIN				
AGLS	34	25	1.13	961
PART	281	20	0.34	1911
CEIL	270	20	0.34	1836
FLOR	270	20	0.34	1836

BYPASS O.A. S	SENSIBLE	LOAD		
<u>CFM</u>	T.DIFF.	BYPASS	FACTOR	BTU
100	25	0.08	1.08	216
	C 5	MAN	HEN.	TECH

PEOPLE	10	245		2450
APPL.	250	3.4	TI	850
LIGHTS	405	3.4	1.25	1721
FOOD	0	60		0
SUB TOTAL				

LEAK LOSS +SAFETY FACTOR=5%	741
ROOM SENSIBLE HEAT	16312

BYPASS OUTSIDE AIR LATENT LOAD					
<u>CFM</u>	G. DIFF BYPASS FACTOR BTU				
100	82	0.08	0.68	446	

INTERNAL LATE	NT LOAD	Barrier .	· INDIA
PEOPLE	10	205	2050

SUB TOTAL	2496
SAFETY FACTOR=5%	125
ROOM LATENT HEAT	2621
ROOM TOTAL HEAT	18933

OUTSIDE AIR HEAT					
	<u>CFM</u>	G. DIFF	<u>1-B.F.</u>	<u>FACTOR</u>	<u>BTU</u>
SENSIBLE	100	25	0.92	1.08	2484
LATENT	100	82	0.92	0.68	5130
SUB TOTAL					7614
TOTAL					26550
HEAT GAIN SAFETY FACTOR @ 3%					796
GRAND TOTAL I	HEAT		(TONS)	2.3	27346

SENSIBLE HEAT FACTOR	0.86
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	755
TONS AS PER Cfm	1.9

GRAND TOTAL HEAT (BTU/HR/SQFT.)	101.29
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	60.43
SQFT/PERSON	27
TONS PER SQFT	0.01
CFM PER SQFT	2.76
TONS/PERSON	0.23
DEHUMIDIFIED CFM/TON	328.26
AREA PER TON	117.39

Table 17. Calculation of CIT-B

6.2.14. AO & PS (B):

SOLAR GAIN-GLASS				
DIRECTION	AREA	T.DIFF.	FACTOR	BTU
NORTH	0	11	0.56	0
SOUTH	0	11	0.56	0
EAST	0	11	0.56	0
WEST	0	165	0.56	0
N-E	0	11	0.56	0
N-W	0	118	0.56	0
S-E	0	11	0.56	0

S-W 0 113 0.56 0

SOLAR & TRANSMISSION GAIN -WALL							
NORTH	0	20	0.34	0			
SOUTH	0	36	0.34	0			
EAST	0	22	0.34	0			
WEST	0	36	0.34	0			
N-E	0	17	0.34	0			
N-W	0	13	0.34	0			
S-E	0	25	0.34	0			
S-W	0	21	0.34	0			
ROOF	210	51	0.15×0	0			

OTHER TRANSMISSION GAIN							
AGLS	0	25	1.13	0			
PART	204	20	0.34	1387			
CEIL	210	20	0.34	1428			
FLOR	210	20	0.34	1428			

BYPASS O.A. SENSIBLE LOAD							
<u>CFM</u> <u>T.DIFF.</u> <u>BYPASS</u> <u>FACTOR</u> <u>BTU</u>							
77	25	0.08	1.08	166			

INTERNAL SENSIBLE LOAD								
PEOPLE	2	245		490				
APPL.	500	3.4		1700				
LIGHTS	315	3.4	1.25	1339				
FOOD	0	60		0				
SUB TOTAL	,	" MU	MBAI	7938				

LEAK LOSS +SAFETY FACTOR=5%	397
ROOM SENSIBLE HEAT	8732

LATENT HEAT:

BYPASS OUTSIDE AIR LATENT LOAD

<u>CFM</u>	G. DIFF	<u>BYPASS</u>	<u>FACTOR</u>	<u>BTU</u>
77	82	0.08	0.68	343

INTERNAL LATENT LOAD
PEOPLE 2 205 410

SUB TOTAL	753
SAFETY FACTOR=5%	38
ROOM LATENT HEAT	791
ROOM TOTAL HEAT	9523

❖ GRAND TOTAL HEAT:

OUTSIDE AIR HEAT								
200	<u>CFM</u>	G. DIFF	<u>1-B.F.</u>	FACTOR	BTU			
SENSIBLE	77	25	0.92	1.08	1913			
LATENT	77	82	0.92	0.68	3950			
SUB TOTAL	7/2	10000	3-1-6.	97,777	5863			
TOTAL	Et.	HY 6 W	7 1 01		15386			
HEAT GAIN SAI	FETY FAC			462				
GRAND TOTAL	HEAT		(TONS)	1.32	15848			

SENSIBLE HEAT FACTOR	0.92
SELECTED A.D.P.	52
DEHUMIDIFIED RISE	20
DEHUMIDIFIED AIR Cfm	404
TONS AS PER Cfm	1.01

GRAND TOTAL HEAT (BTU/HR/SQFT.)	75.47
ROOM SENSIBLE HEAT (BTU/HR/SQFT.)	41.58
SQFT/PERSON	105
TONS PER SQFT	0.01
CFM PER SQFT	1.92
TONS/PERSON	0.66
DEHUMIDIFIED CFM/TON	306.06
AREA PER TON	159.09

Table 18. Calculation of AO&PS(B)

6.3. Summary:

	SUBJECT: HEAT LOAD SUMMARY SHEET									
	PROJECT:		INCOME TAX OFFICE GROUND FLOOR							
SR.	DISCRIPTION	Area	Occupancy	WATTS	Fresh air	APPL.	Dehumidified	Tonnage	Cfm/Hp	Tonnage
		Sq. Ft.	Nos.	Sq. Ft.	CFM	WATTS.	air	REQ. (TR)		HP
1	STAFF AREA - 1	1400	30	1.5	513	5000	3354	10.3	13.41	12.4
2	DCIT - 1	200	7	1.5	73	250	403	1.38	1.61	1.66
3	DCIT - 2	200	7	1.5	73	250	403	1.38	1.61	1.66
4	ITO - 1	190	6	1.5	70	250	550	1.6	2.2	1.92
5	ITO - 2	190	6	1.5	70	250	418	1.4	1.67	1.68
6	ITO - 3	190	6	1.5	70	250	513	1.5	2.05	1.8
7	ITO - 4	190	6	1.5	70	250	511	1.6	2.04	1.92
8	STAFF AREA - 2	1200	30	1.5	440	5000	3224	9.58	12.89	11.54
9	CIT A	270	10	1.5	99	250	754	2.3	3.01	2.77
10	AO AND PSA	240	6	1.5	88	500	608	1.85	2.43	2.22
11	JCTI -1	290	10	1.5	106	250	842	2.48	3.36	2.98
12	ADDL JCTI - 1	270	10	1.5	99	250	668	2.1	2.67	2.53
13	CIT (B)	270	10	1.5	99	250	755	2.3	3.02	2.77
14	AO AND PS (B)	210	2	1.5	77	500	404	1.32	1.61	1.59
	TOTAL	5310	146	21	1947	13500	13407	41	53.6	49.5

Table 19.Result of Design

6.4. Selection of outdoor & Indoor Unit Capacity:

6.4.1 Outdoor unit:

SR.NO.	OUTDOOR UNIT	HP
1.	MMY-MAP14A7T8P	14
2.	MMY-MAP14A7T8P	14
3.	MMY-MAP14A7T8P	14
4.	MMY-MAP14A7T8P	14
TOTAL	56	

Table 20. Selection of Outdoor Unit

6.4.2. Indoor unit:

SR NO	NAME OF ROOM	TYPE OF IDU & MODEL NO.	NOS. OF IDU	IDU HP
1.	STAFF AREA- 1	4-way cassette MMU- AP0364HP1-E	4	4HP
2.	DCIT-1	4-way cassette MMU- AP0274HP1-E	且差	3HP
3.	DCIT-2	4-way cassette MMU- AP0274HP1-E		3HP
4.	ITO-1	4-way cassette MMU- AP0274HP1-E	11 83	3НР
5.	ITO-2	4-way cassette MMU- AP0274HP1-E	1. 3	3НР
6.	ITO-3	4-way cassette MMU- AP0274HP1-E		3НР
7.	ITO-4	4-way cassette MMU- AP0274HP1-E	1	3НР
8.	STAFF AREA- 2	4-way cassette MMU- AP0364HP1-E	3	4HP
9.	CIT A	4-way cassette MMU- AP0364HP1-E	1	4HP
10.	AO AND PS (A)	4-way cassette MMU- AP0274HP1-E	1	3HP
11.	JCTI-1	4-way cassette MMU- AP0364HP1-E	1	4HP
12.	ADDL JCTI-1	4-way cassette MMU- AP0364HP1-E	1	4HP

13.	CIT (B)	4-way cassette MMU-	1	4HP
		AP0364HP1-E		
14.	AO AND PS	4-way cassette MMU-	1	3НР
	(B)	AP0274HP1-E		
TOTAL				68HP

Table 21. Selection of Indoor Unit

DIVERSITY=
$$\frac{INDOOR\ UNIT\ CAPACITY}{OUTDOOR\ UNIT\ CAPACITY} \times 100 = \frac{68}{56} \times 100 = 121\%$$

The outdoor unit & indoor unit models according to the capacity are selected from Toshiba catalogue.

In Toshiba there is a chance to get diversity up to 135% if numbers of occupants are increases in room it will not affects the efficiency of system.

6.5. Pipe Size and Details

Pipe material= copper

For outdoor unit connecting pipe (Model MMY-MAP14A7T8P pipe dimension selected

Gas side = \emptyset 28.6mm, Liquid side= \emptyset 15.9mm

Between ODU connection piping kits: - Gas side=Ø41.3mm, Liquid side=Ø22.2mm

IDU connection piping kit of header unit: - Gas side=Ø41.3mm, Liquid side=Ø22.2mm

Between 2 y-joints pipe size differs according to equivalent HP

IDU connecting pipe as per the capacity of IDU

RAFFNATES according to equivalent HP

ODU connecting kit selected as per the equivalent HP

6.6. Insulation:

Standard insulation pipe thickness

Supply pipe insulation=19mm

Return pipe insulation=13mm

CHAPTER 07

7. VALIDATION OF RESULT

-	ROUND FLO		01, 0	1 1(2)	OCL	<u>-</u>	
JOB . G	IKOOND FLO	OK				HEAT LOAD CALCULATIONS	
SPACE: S	TAFF AREA-	1				DATE TIME	3/10/2020 18:23
_	FOIGH DATA						
l —	ESIGN DATA REA:				1400		
	IT.OF THE AR	REA:			11		
	IGHTING (WA		QFT)		1.5	HEAT LOAD SUMMARY TR	HP
	O.OF AIR CH				2	GRAND TOTAL HEAT 10.3	
c	fm VENTILAT	ΓΙΟΝ			513	DEHUMIDIFIED AIR Cfm 3314	
c	fm/PERSON				10		
	O.OF PEOPL				30	TONS AS PER Cfm 8.3	
	fm VENTILAT				300	TONNAGE REQUIRED 10.3	12.45
<u> </u>	fm VENTILAT	TION IN	CAL.		513	OFM RED COST	
		D D	W D	0/8/1	CD/I D	CFM PER SQFT 2.37	
	UTSIDE	<u>D.B.</u> 100	W.B. 83	<u>%RH</u> 60	146.0	AREA PER TON 135	
	NSIDE	75	- 00	50	64.0	PEDETREE AD THE	
	IFF.	25	16.3	1.0	82.0	166-11/11/01/19 " CALLED	
_			L.Y	253.0			
			1 1 1				
		GAIN	87 165			BYPASS O.A. LATENT LOAD	
	AREA or T.	DIFF.	FACTOR	- 99	BTU	CFM G.DIFF BYPASS FACTOR	BTU
601 4B 0 ::	IN CLASS	-31	100	796	S. 174	513 82 0.08 0.68	2290
SOLAR GAI	0	11	0.56	75.	0	INTERNAL LATENT LOAD	
SOUTH	0	11	0.56	10	0	PEOPLE 30 205	6150
EAST	19	11	0.56	7.6	117	1 BOTTLE 30 203	0130
WEST	0	165	0.56		0	SUB TOTAL	8440
N-E	0	11	0.56	- 1	0		0110
N-W	0	118	0.56		0	SAFETY FACTOR=5%	422
S-E	0	11	0.56	- 1	0	ROOM LATENT HEAT	8862
S-W	0	113	0.56		0		
	- 55	-				ROOM TOTAL HEAT	81313
SOLAR & T	RANSMISSIC	N GAI	N			and the state of t	
NORTH	0	20	0.34		0	OUTSIDE AIR HEAT	
SOUTH	0	36	0.34		0	_300111111111	
EAST	52	22	0.34		390	<u>CFM</u> <u>G.DIFF</u> <u>1-B.F.</u> <u>FACTOR</u>	
WEST	363	36	0.34		4443	SENS 513 25 0.92 1.08	12751
N-E N-W	0	17	0.34 0.34		0	LAT 513 82 0.92 0.68	26334
S-E	0	13 25	0.34		0	SUB TOTAL	39085
S-E S-W	0	21	0.34		0	TOTAL	120397
ROOF	1400	51	0.15	0	0	1.11	0001
			0.10			HEAT GAIN SAFETY FACTOR @ 3%	3612
				10			
OTHER TRA	NSMISSION	GAIN		1811	100	GRAND TOTAL HEAT (TONS) 10.3	124009
AGLS	19	25	1.13	- 4	534	181111 181 No.	
PART	1023	20	0.34		6956	VILLAGRAL - 155	
CEIL	1400	20	0.34	1	9520	SENSIBLE HEAT FACTOR	0.89
FLOR	1400	20	0.34	1	9520	SELECTED A.D.P.	52
DVDACC C	A CENCIDIT		, 1			DEHUMIDIFIED RISE	20
DIPASS 0.	A. SENSIBLE					DEHUMIDIFIED AIR Cfm	3314
	<u>CFM T.</u> 513	<u>.DIFF.</u> 25	FACTOR 0.08	1.08	1109	TONS AS PER Cfm	3314 8.3
	0.13	23	5.00	00	. 103	. C. O NO I EN CHI	0.3
INTERNAL	SENSIBLE LO	DAD				CHECK RESULTS.	
PEOPLE	30	245			7350	GRAND TOTAL HEAT(BTU/HR/SQFT.)	88.58
APPL.	5000	3.4			17000	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	51.75
LIGHTS	2100	3.4		1.25	8925	SQFT/PERSON	46.67
FOOD	0	60			0	TONS PER SQFT	0.01
SUB TOT	55				65864	CFM PER SQFT	2.37
						TONS/PERSON	0.34
	+SAFETY FAC	CTOR=	5%		3293	DEHUMIDIFIED CFM/TON	320.73
ROOM SEN	SIBLE HEAT				72451	AREA PER TON	135.47

JOB :	GROUND FL	.OOR					
						HEAT LOAD CALCULATIONS	
SPACE:	DCIT - 1					DATE TIME	3/10/2020 18:23
	DESIGN DA	ТΔ					
	AREA:				200		
	HT.OF THE	AREA:			11		
	LIGHTING (WATTS/S	QFT)		1.5	HEAT LOAD SUMMARY TR	HP
	NO.OF AIR	CHANGE	REQUIRED		2	GRAND TOTAL HEAT 1.4	
	Cfm VENTIL				73	DEHUMIDIFIED AIR Cfm 398	
	Cfm/PERSO				10		
	NO.OF PEO				7	TONS AS PER Cfm 1.0 TONNAGE REQUIRED 1.4	4.07
	Cfm VENTIL		I CAI		70 73	TONNAGE REQUIRED 1.4	1.67
	CIIII VENTIL	ATTON II	V CAL.		13	CFM PER SQFT 1.99	
		D.B.	W.B.	%RH	GR/LB	AREA PER TON 144	
	OUTSIDE	100	83	60	146	E-1-378	
	INSIDE	75	-	50	64.0	(17) (17) (17) (17)	
	DIFF.	25	_		82.0	PERLEDIN TERR	
			- 1	200	4.1	***************************************	
		N GAIN	476	1,000		BYPASS O.A. LATENT LOAD	
		· T.DIFF.	FACTOR	b)	BTU	CFM GDIFF BYPASS FACTOR 73 82 0.08 0.68	<u>BTU</u> 32 7
	AIN-GLASS					- TROUT - 12.10	
NORTH	0	11	0.56	9300	0	INTERNAL LATENT LOAD	446
SOUTH	0	11	0.56	5653	0	PEOPLE 7 205	1435
EAST WEST	0	11 165	0.56 0.56	25.40	0	SUB TOTAL	1762
N-E	0	11	0.56	16/00	0	SOBTOTAL	1702
N-E N-W	0	118	0.56	7.60	0	SAFETY FACTOR=5%	88
S-E	0	11	0.56	153	0	ROOM LATENT HEAT	1850
S-W	0	113	0.56	- Dri	0	ACCOUNT EAT EAT THEAT	1030
3-11		113	0.30		ĭ	ROOM TOTAL HEAT	10557
SOLAR &	TRANSMISS	SION GAI	N			N 7794 T. 1 > 5	
NORTH	0	20	0.34	- 10	0	OUTSIDE AIR HEAT	
SOUTH	0	36	0.34		0	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
EAST	0	22	0.34		0	<u>CFM</u> <u>G.DIFF</u> <u>1-B.F.</u> <u>FACTOR</u>	
WEST	0	36	0.34		0	SENS 73 25 0.92 1.08	1822
N-E	0	17	0.34		0	LAT 73 82 0.92 0.68	3762
N-W	0	13	0.34		0		
S-E	0	25	0.34		0	SUB TOTAL	5584
S-W	0	21	0.34		0	TOTAL	16140
ROOF	200	51	0.15	0	0		
						HEAT GAIN SAFETY FACTOR @ 3%	484
	RANSMISSIC					GRAND TOTAL HEAT (TONS) 1.4	16625
AGLS	0	25	1.13	MA.	0	210	
PART	176	20	0.34	191	1197	OCHODIC UPLY CLASSES	
CEIL	200	20	0.34	1	1360	SENSIBLE HEAT FACTOR	0.82
FLOR	200	20	0.34	1	1360	SELECTED A.D.P. DEHUMIDIFIED RISE	52 20
BYPASS	D.A. SENSIB	IFIOAD	,			DE TOMIDII IED NIGE	20
2 7.00 (CFM		FACTOR			DEHUMIDIFIED AIR Cfm	398
	73	25	0.08	1.08	158	TONS AS PER Cfm	1.0
INTERNAI	SENSIBLE	LOAD				CHECK RESULTS.	
PEOPLE	7	245			1715	GRAND TOTAL HEAT(BTU/HR/SQFT.)	83.12
APPL.	250	3.4			850	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	43.53
LIGHTS	300	3.4		1.25	1275	SQFT/PERSON	28.57
FOOD	0	60		-	0	TONS PER SQFT	0.01
SUB TOTA					7915	CFM PER SQFT	1.99
						TONS/PERSON	0.20
LEAK LOS	S +SAFETY I	ACTOR=	5%		396	DEHUMIDIFIED CFM/TON	287.51
	NSIBLE HEA	_			8707	AREA PER TON	144.36

JOB :	GROUND F	LOOR										
						HEAT LOAD CALCULATIONS						
SPACE:	DCIT - 2					DATE TIME	3/10/2020 18:23					
	DESIGN DATA											
	AREA:				200							
	HT.OF THE				11							
	LIGHTING (•		1.5	HEAT LOAD SUMMARY TR	HP					
	NO.OF AIR		REQUIRED)	73	GRAND TOTAL HEAT 1.4						
	Cfm/PERSC				10	DEHUMIDIFIED AIR Cfm 398						
	NO.OF PEO				7	TONS AS PER Cfm 1.0						
	Cfm VENTII	LATION			70	TONNAGE REQUIRED 1.4	1.67					
	Cfm VENTII	LATION IN	I CAL.		73							
						CFM PER SQFT 1.99						
	OUTSIDE	D.B.	W.B.	<u>%RH</u>	GR/LB	AREA PER TON 144						
	OUTSIDE	100 75	83	60 50	146 64.0							
	DIFF.	25		30	82.0	PERLICIPAL TECH						
			100	451	A Party	THE PARTY OF THE P						
	<u>S</u> 1	UN GAIN	4.0	Y 66	*	BYPASS O.A. LATENT LOAD						
	AREA o	r T.DIFF.	FACTOR	53-7	BTU	CFM G.DIFF BYPASS FACTOR	BTU 227					
SOLAR G	AIN-GLASS		100		TI	73 82 0.08 0.68	327					
NORTH	0	11	0.56	Dist.	0	INTERNAL LATENT LOAD						
SOUTH	0	11	0.56	DE	0	PEOPLE 7 205	1435					
EAST	0	11	0.56	938	0	242						
WEST	0	165	0.56	15 C	0	SUB TOTAL	1762					
N-E	0	11	0.56	76	0							
N-W	0	118	0.56	101	0	SAFETY FACTOR=5%	88					
S-E	0	11	0.56	- 108	0	ROOM LATENT HEAT	1850					
S-W	0	113	0.56	- 111	0	ROOM TOTAL HEAT	10557					
SOLAR &	TRANSMIS	SION GAII	N	- 155		POST POST PER	10001					
NORTH	0	20	0.34		0	OUTSIDE AIR HEAT						
SOUTH	0	36	0.34	- 111	0							
EAST	0	22	0.34		0	<u>CFM</u> <u>G.DIFF</u> <u>1-B.F.</u> <u>FACTOR</u>						
WEST	0	36	0.34		0	SENS 73 25 0.92 1.08	1822					
N-E	0	17	0.34		0	LAT 73 82 0.92 0.68	3762					
N-W	0	13	0.34	M -	0	CONTRACTOR OF THE PARTY AND TH						
S-E S-W	0	25 21	0.34		0	SUB TOTAL TOTAL	5584 16140					
ROOF	200	51	0.34	0	0	TOTAL	10140					
1001	200			40		HEAT GAIN SAFETY FACTOR @ 3%	484					
OTHER T	RANSMISSI	ON GAIN			L/R	GRAND TOTAL HEAT (TONS) 1.4	16625					
AGLS	0	25	1.13	110	0	41-						
PART	176	20	0.34	11/4	1197	(ALD) by						
CEIL	200	20	0.34	1	1360	SENSIBLE HEAT FACTOR	0.82					
FLOR	200	20	0.34	1	1360	SELECTED A.D.P.	52					
BYPASS	O.A. SENSIE	BLE LOAD	,			DEHUMIDIFIED RISE	20					
2 A00	CFM		FACTOR			DEHUMIDIFIED AIR Cfm	398					
	73	25	0.08	1.08	158	TONS AS PER Cfm	1.0					
INTERNA	L SENSIBLE	LOAD				CHECK RESULTS.						
PEOPLE	7	245			1715	GRAND TOTAL HEAT(BTU/HR/SQFT.)	83.12					
APPL.	250	3.4			850	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	43.53					
LIGHTS	300	3.4		1.25	1275	SQFT/PERSON	28.57					
FOOD	0	60			0	TONS PER SQFT	0.01					
SUB TOT	AL				7915	CFM PER SQFT	1.99					
						TONS/PERSON	0.20					
	SS +SAFETY I		5%		396 8707	DEHUMIDIFIED CFM/TON A DEA DED TON	287.51					
KOOW SE	ENSIBLE HE	41			0/0/	AREA PER TON	144.36					

JOB :	GROUND FLOOR			T	
				HEAT LOAD CALCULATIONS	
SPACE :	ITO - 1			DATE	3/10/2020
				TIME	18:13
	DESIGN DATA			l e e e e e e e e e e e e e e e e e e e	
	AREA:		190		
	HT.OF THE AREA:		11		
	LIGHTING (WATTS/S	QFT)	1.5	HEAT LOAD SUMMARY TR	HP
	NO.OF AIR CHANGE	REQUIRED	2	GRAND TOTAL HEAT 1.6	
	Cfm VENTILATION		70	DEHUMIDIFIED AIR Cfm 545	
	Cfm/PERSON		10		
	NO.OF PEOPLE		6	TONS AS PER Cfm 1.4	
	Cfm VENTILATION		60	TONNAGE REQUIRED 1.6	1.95
	Cfm VENTILATION IN	CAL.	70		
				CFM PER SQFT 2.87	
	D.B.	W.B.	%RH GR/LB	AREA PER TON 118	
	OUTSIDE 100		60 146	MODIFICATION	
	INSIDE 75		50 64.0	PAGE TEN	
			- HE THE BOOK TO THE	ALMHITTHIN FECTION	
	DIFF. 25	- 4	- 82.0	Light Company of the	
		1. 163	Carlotte Comment	175 VT WIN ARENT	
		43.	A 330 - 17-1		
	SUN GAIN	4 30	3" (2)	BYPASS O.A. LATENT LOAD	
	AREA or T.DIFF.	FACTOR	BTU	<u>CFM</u> <u>G.DIFF</u> <u>BYPASS</u> <u>FACTOR</u>	BTU
_	100	120	. 17	70 82 0.08 0.68	311
	GAIN-GLASS	13.7	PROJECT		
NORTH SOUTH	44 11 0 11	0.56 0.56	273 0	INTERNAL LATENT LOAD PEOPLE 6 205	1230
EAST	0 11	0.56	0	TEOLEE 0 203	1230
WEST	0 165		0	SUB TOTAL	1541
N-E	0 11	0.56	0	[[인하님]] [[인하]] [[인하]] [[인하]]	
N-W	0 118	0.56	0	SAFETY FACTOR=5%	
S-E	0 11	0.56	0	ROOM LATENT HEAT	1618
S-W	0 113	0.56	0	DOOM TOTAL LIFAT	42500
SOLAR 8	R TRANSMISSION GAIN			ROOM TOTAL HEAT	13526
NORTH	78 20		527	OUTSIDE AIR HEAT	
SOUTH	0 36		0	OUTSIDE AIR HEAT	
EAST	0 22		0	CFM G.DIFF 1-B.F. FACTOR	
					4704
WEST	0 36		0	SENS 70 25 0.92 1.08	1731
N-E	0 17	0.34	0	LAT 70 82 0.92 0.68	3574
N-W	0 13		0	Committee of the commit	
S-E	0 25		0	SUB TOTAL	5304
S-W	0 21	0.34	0	TOTAL	18830
ROOF	190 51	0.15	0 0		
			100 110 10	HEAT GAIN SAFETY FACTOR @ 3%	565
			TO 1 188		
OTHER T	RANSMISSION GAIN		4.	GRAND TOTAL HEAT (TONS) 1.6	19395
AGLS	44 25		1252	Alm	
PART	369 20		2507	errest of the same	
CEIL	190 20	0.34	1 1292	SENSIBLE HEAT FACTOR	0.88
FLOR	190 20	0.34	1 1292	SELECTED A.D.P.	52
				DEHUMIDIFIED RISE	20
BYPASS	O.A. SENSIBLE LOAD				
		FACTOR		DEHUMIDIFIED AIR Cfm	545
	70 25	0.08	1.08 150	TONS AS PER Cfm	1.4
INTERNA	AL SENSIBLE LOAD			CHECK RESULTS.	
PEOPLE	6 245		1470	GRAND TOTAL HEAT(BTU/HR/SQFT.)	102.08
APPL.	250 3.4		850	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	62.67
LIGHTS	285 3.4		1.25 1211	SQFT/PERSON TONG DED SOFT	31.67
FOOD SUB TOT	0 60		0 10825	TONS PER SQFT CFM PER SQFT	0.01 2.87
305 101	I DE		10025		
	SS +SAFETY FACTOR=5	0/_	541	TONS/PERSON DEHUMIDIFIED CFM/TON	0.27 337.05
TEATER	OO TOAFLII FACIUR=5	/0	541	DEMONIDIFIED CENTION	337.05
	ENSIBLE HEAT		11908	AREA PER TON	117.56

JOB :	GROUND FL	.OOR				-	
CDACE .	ITO 0					HEAT LOAD CALCULATIONS	2/40/2022
SPACE:	110 -2					DATE TIME	3/10/2020 18:16
	DESIGN DA	ГА					
	AREA:				190		
	HT.OF THE				11		
	LIGHTING (•		1.5	HEAT LOAD SUMMARY TR	HP
	NO.OF AIR (KEQUIKED		2 70	GRAND TOTAL HEAT 1.4 DEHUMIDIFIED AIR Cfm 413	
	Cfm/PERSO				10	DETOMININED AIR OIL	
	NO.OF PEO	PLE			6	TONS AS PER Cfm 1.0	
	Cfm VENTIL	ATION			60	TONNAGE REQUIRED 1.4	1.65
	Cfm VENTIL	ATION II	N CAL.		70		
			=		"-	CFM PER SQFT 2.18	
	OUTSIDE	<u>D.B.</u> 100	<u>W.B.</u> 83	<u>%RH</u> 60	<u>GR/LB</u> 146	AREA PER TON 139	
	INSIDE	75	-	50	64.0		
	DIFF.	25	-	-	82.0	CHINE WA	
			- 4	433	'WW	THE ECHAL	
	SI	N GAIN	14.	200		BYPASS O.A. LATENT LOAD	
	AREA or	T.DIFF.	FACTOR	100	BTU	<u>CFM G.DIFF BYPASS FACTOR</u>	<u>BTU</u>
		- 4	- Y N	3.	1	70 82 0.08 0.68	311
	SAIN-GLASS	-21	4 1955		TT	TELEVIE C. C.	
NORTH	42	11	0.56		257	INTERNAL LATENT LOAD	
SOUTH	0	11	0.56	100	0	PEOPLE 6 205	1230
EAST WEST	0	11 165	0.56 0.56	039	0	SUB TOTAL	1541
N-E	0	11	0.56	D.C	0	SUBTUTAL	1341
N-W	0	118	0.56	772	0	SAFETY FACTOR=5%	77
S-E	0	11	0.56	44	0	ROOM LATENT HEAT	1618
S-W	0	113	0.56	- 199	0		
				- 111	Ш	ROOM TOTAL HEAT	10656
SOLAR &	TRANSMISS	ION GAI	N	- HU		AND DESCRIPTION SE	
NORTH	81	20	0.34	- 171	554	OUTSIDE AIR HEAT	
SOUTH	0	36	0.34		0	7 1 1992001 17	
EAST	0	22	0.34		0	CEM GDIFF 1-B.F. FACTOR	4704
WEST N-E	0	36 17	0.34 0.34		0	SENS 70 25 0.92 1.08 LAT 70 82 0.92 0.68	1731 3574
N-E N-W	0	17	0.34		0	LAI 70 82 0.92 0.66	33/4
S-E	0	25	0.34		0	SUB TOTAL	5304
S-W	0	21	0.34		0	TOTAL	15960
ROOF	190	51	0.15	0	0	AND DESCRIPTION OF THE PERSON NAMED IN COLUMN 1	
		- 44			1.000	HEAT GAIN SAFETY FACTOR @ 3%	479
	RANSMISSIC					GRAND TOTAL HEAT (TONS) 1.4	16 <u>439</u>
AGLS	42	25	1.13	Ma.	1179	ALL	
PART	184	20	0.34	191	1254	SENSIBI E HEAT EACTOR	0.05
CEIL FLOR	190 190	20 20	0.34 0.34	0	1292	SENSIBLE HEAT FACTOR SELECTED A.D.P.	0.85 52
LOK	130	20	0.54	0	- 0	DEHUMIDIFIED RISE	20
BYPASS	O.A. SENSIB	LE LOAD)				
	<u>CFM</u>		FACTOR			DEHUMIDIFIED AIR Cfm	413
	70	25	0.08	1.08	150	TONS AS PER Cfm	1.0
INTERNA	I CENCIDI E	1045				CHECK DESIII TS	
PEOPLE	L SENSIBLE 6	245			1470	CHECK RESULTS. GRAND TOTAL HEAT(BTU/HR/SQFT.)	86.52
APPL.	250	3.4			850	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	47.57
LIGHTS	285	3.4		1.25	1211	SQFT/PERSON	31.67
FOOD	0	60		20	0	TONS PER SQFT	0.01
SUB TOT					8217	CFM PER SQFT	2.18
						TONS/PERSON	0.23
LEAK LOS	SS +SAFETY F		5%		411	DEHUMIDIFIED CFM/TON	301.82
	ENSIBLE HEA	-			9038	AREA PER TON	138.69

JOB :	GROUND FLO	OR				
]					HEAT LOAD CALCULATIONS	
SPACE :	ITO - 3				DATE	3/10/2020
					TIME	18:32
	DESIGN DATA	A				
	AREA:			190		
	HT.OF THE AI	REA:		11		
	LIGHTING (W	ATTS/SC	QFT)	1.5	HEAT LOAD SUMMARY TR	HP
	NO.OF AIR CH	HANGE R	REQUIRED	2	GRAND TOTAL HEAT 1.5	
	Cfm VENTILA	TION		70	DEHUMIDIFIED AIR Cfm 507	
	Cfm/PERSON			10		
	NO.OF PEOPI	LE		6	TONS AS PER Cfm 1.3	
	Cfm VENTILA	TION		60	TONNAGE REQUIRED 1.5	1.86
	Cfm VENTILA	TION IN	CAL.	70		
					CFM PER SQFT 2.67	
		D.B.	<u>W.B.</u>	%RH GR/LB	AREA PER TON 123	
	OUTSIDE	100	83	60 146	37-38 Pr-	
	INSIDE	75	- 2	50 64.0	Harally, IECL.	
	DIFF.	25	- 53	- 82.0	The state of the s	
			834	55 67	STORES ARESTE	
		- 14	N 143	O Fift;		_
		UN GAIN	1997	TEN 1	BYPASS O.A. LATENT LOAD	
	AREA o	r T.DIFF.	FACTOR	BTU	CFM G.DIFF BYPASS FACTOR	BTU
SOLAR G	AIN-GLASS	100	T 150	- Indiana	70 82 0.08 0.68	311
NORTH	39	11	0.56	238	INTERNAL LATENT LOAD	
SOUTH	0	11	0.56	0	PEOPLE 6 205	1230
EAST	57	11	0.56	351	34 1 1 1 1 1 1 1 1 1	
WEST	0	165	0.56	0	SUB TOTAL	1541
N-E N-W	0	11 118	0.56 0.56	0	SAFETY FACTOR=5%	77
S-E	0	11	0.56	0	ROOM LATENT HEAT	1618
S-W	0	113	0.56	0		
201 45 0	TRANSMISSI	011 0 4 111			ROOM TOTAL HEAT	12698
	TRANSMISSI			74 I I I I I I I I I I I I I I I I I I I	111111111111111111111111111111111111111	
NORTH SOUTH	81	20 36	0.34	553	OUTSIDE AIR HEAT	
EAST	0	22	0.34	0	CFM G.DIFF 1-B.F. FACTOR	
WEST	0			0	SENS 70 25 0.92 1.08	1731
	1	36	0.34			
N-E	0	17	0.34	0	LAT 70 82 0.92 0.68	3574
N-W S-E	0	13 25	0.34 0.34	0	SUB TOTAL	5304
S-W	0	21	0.34	0	TOTAL	18002
	190	51	0.15	0 0	TOTAL	10002
ROOF	190	51	0.15	0 0	HEAT GAIN SAFETY FACTOR @ 3%	540
				4 / 10 700	HEAT GAIN SAFETY FACTOR @ 3%	540
OTLIED T	DANCHICCION	LCAIN	- 41		CRAND TOTAL LIFAT (TONG) 4.5	40540
AGLS	RANSMISSION 96	25	1.13	2703	GRAND TOTAL HEAT (TONS) 1.5	18542
PART	184	20	0.34	1254	13/1/11	
CEIL	190	20	0.34	1 1292	SENSIBLE HEAT FACTOR	0.87
FLOR	190	20	0.34	0 0	SELECTED A.D.P.	52
					DEHUMIDIFIED RISE	20
BYPASS	O.A. SENSIBLI		EACTOR		DEMINIDIESED ASP Com	F07
	CFM 70		FACTOR	1.09 450	DEHUMIDIFIED AIR Cfm	507
	70	25	0.08	1.08 150	TONS AS PER Cfm	1.3
INTERNA	L SENSIBLE L	OAD			CHECK RESULTS.	
PEOPLE	6	245		1470	GRAND TOTAL HEAT(BTU/HR/SQFT.)	97.59
APPL.	250	3.4		850	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	58.32
LIGHTS	285	3.4		1.25 1211	SQFT/PERSON	31.67
FOOD	0	60		0	TONS PER SQFT	0.01
SUB TOT	AL			10073	CFM PER SQFT	2.67
LEAVE	DO LO A PROPERTY	CTOP 5	0/		TONS/PERSON	0.26
	SS +SAFETY FA ENSIBLE HEAT		70	504 11080	DEHUMIDIFIED CFM/TON AREA PER TON	328.04 122.96
NOOIVI SE	LIVOIDEE HEAT			11000	MARKET LAN TON	122.30

JOB :	GROUND FL	OOR				<u> </u>	
SPACE:	ITO - 4					HEAT LOAD CALCULATIONS DATE	3/10/2020
SPACE.	110-4					TIME	18:32
Г	DESIGN DAT	ΓΔ					
F	AREA:				190		
	HT.OF THE	AREA:			11		
	LIGHTING (V				1.5	HEAT LOAD SUMMARY TR	HP
	NO.OF AIR		REQUIRED		2	GRAND TOTAL HEAT 1.6	
	Cfm VENTIL Cfm/PERSO				70 10	DEHUMIDIFIED AIR Cfm 530	
	NO.OF PEO				6	TONS AS PER Cfm 1.3	
	Cfm VENTIL				60	TONNAGE REQUIRED 1.6	1.91
	Cfm VENTIL	ATION IN	I CAL.		70		
						CFM PER SQFT 2.79	
		<u>D.B.</u>	<u>W.B.</u>	<u>%RH</u>	GR/LB	AREA PER TON 120	
l I	OUTSIDE INSIDE	100 75	83	60 50	146 64.0		
	DIFF.	75 25		50	82.0	CHI-RA Pre-	
L	DII 1 .	20		432	AT A	THE CHALL	
	SL	N GAIN	183	1	1 1	BYPASS O.A. LATENT LOAD	
	AREA or	T.DIFF.	FACTOR	1555	BTU	CFM G.DIFF BYPASS FACTOR	BTU
		-45	3 36	93.	CTI	70 82 0.08 0.68	311
	AIN-GLASS		1000			The british O. Co	
NORTH	39	11	0.56		238	INTERNAL LATENT LOAD	4000
SOUTH EAST	0 32	11	0.56	525	200	PEOPLE 6 205	1230
WEST	0	165	0.56	498	0	SUB TOTAL	1541
N-E	0	11	0.56	7.5	0		1341
N-W	0	118	0.56	160	0	SAFETY FACTOR=5%	77
S-E	0	11	0.56	86	0	ROOM LATENT HEAT	1618
S-W	0	113	0.56	1079	0	CM LINES DE PE	
			. 1		H Fat	ROOM TOTAL HEAT	13210
NORTH	TRANSMISS 92	20	0.34	- 153	626	OUTSIDE AIR HEAT	
SOUTH	0	36	0.34	- 111	020	OUTSIDE AIRTHEAT	
EAST	160	22	0.34	- 1.1.1	1198	CFM G.DIFF 1-B.F. FACTOR	
WEST	0	36	0.34		0	SENS 70 25 0.92 1.08	1731
N-E	0	17	0.34		0	LAT 70 82 0.92 0.68	3574
N-W	0	13	0.34		0	7	
S-E	0	25	0.34	M	0	SUB TOTAL	5304
S-W	0	21	0.34	100	0	TOTAL	18514
ROOF	190	51	0.15	0	0	HEAT GAIN SAFETY FACTOR @ 3%	555
					1896	HEAT GAIN SAFETT FACTOR @ 3%	333
OTHER TR	RANSMISSIC	N GAIN		40.	1 1	GRAND TOTAL HEAT (TONS) 1.6	19070
AGLS	71	25	1.13	4.	2010		
PART	0	20	0.34	N_{A} .	0	Alm	
CEIL	190	20	0.34	1	1292	SENSIBLE HEAT FACTOR	0.88
FLOR	190	20	0.34	1	1292	SELECTED A.D.P. DEHUMIDIFIED RISE	52
BYPASS	D.A. SENSIB	LE LOAD	,			DETIGNATION VISE	20
	<u>CFM</u>		FACTOR			DEHUMIDIFIED AIR Cfm	530
	70	25	0.08	1.08	150	TONS AS PER Cfm	1.3
INTERNAL	SENSIBLE	LOAD				CHECK RESULTS.	
PEOPLE	6	245			1470	GRAND TOTAL HEAT(BTU/HR/SQFT.)	100.37
APPL.	250	3.4			850	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	61.01
LIGHTS	285	3.4		1.25	1211	SQFT/PERSON	31.67
	0	60			0	TONS PER SQFT	0.01
FOOD							
FOOD SUB TOTA					10538	CFM PER SQFT	2.79
SUB TOTA		ACTOR	5 0/		10538 527	CFM PER SQFT TONS/PERSON DEHUMIDIFIED CFM/TON	2.79 0.26 333.71

JOB :	GROUND FL	OOR					
00405	07455 455					HEAT LOAD CALCULATIONS	0/40/00==
SPACE:	STAFF ARE	A - 2				DATE TIME	3/10/2020 18:32
	DESIGN DA	TA					
	AREA:	•			1200		
	HT.OF THE				11		
	LIGHTING (•		1.5	HEAT LOAD SUMMARY TR GRAND TOTAL HEAT 9.6	HP
	NO.OF AIR		KEQUIKED		2 440	GRAND TOTAL HEAT 9.6 DEHUMIDIFIED AIR Cfm 3180	
	Cfm/PERSO				10	DEHOMIDITIED AIR GIII	
	NO.OF PEO				30	TONS AS PER Cfm 8.0	
	Cfm VENTIL	ATION			300	TONNAGE REQUIRED 9.6	11.53
	Cfm VENTIL	ATION IN	I CAL.		440	OF WINDS COST	
		D.B.	W.B.	%RH	GR/LB	CFM PER SQFT 2.65 AREA PER TON 125	
	OUTSIDE	100	83	60	146.0	AREA FER TON 123	
	INSIDE	75	-	50	64.0	MARTIN	
	DIFF.	25	-	- 4	82.0	MELCON TECH	
			1	200		THE PARTY OF THE P	
	SI	JN GAIN	47.00	100	V 160	BYPASS O.A. LATENT LOAD	
	AREA or	T.DIFF.	FACTOR	695	BTU	<u>CFM</u> <u>G.DIFF</u> <u>BYPASS</u> <u>FACTOR</u>	<u>BTU</u>
SOL 45 C	SAIN-GLASS	- 15	7,43		+14 11	440 82 0.08 0.68	1963
NORTH	JAIN-GLASS 141	11	0.56		871	INTERNAL LATENT LOAD	
SOUTH	0	11	0.56	EFR	0	PEOPLE 30 205	6150
EAST	0	11	0.56	034	0		0.00
WEST	0	165	0.56	15-74	0	SUB TOTAL	8113
N-E	0	11	0.56	723	0		
N-W	0	118	0.56	1944	0	SAFETY FACTOR=5%	406
S-E	0	11	0.56	- 633	0	ROOM LATENT HEAT	8518
S-W	0	113	0.56	- 1141	0	DOOM TOTAL USAT	70000
SOLAR 8	R TRANSMISS	SION GAIL	u l	- Hui		ROOM TOTAL HEAT	78038
NORTH	112	20	0.34	- 1711	758	OUTSIDE AIR HEAT	
SOUTH	0	36	0.34		0	FI	
EAST	0	22	0.34		0	<u>CFM G.DIFF 1-B.F. FACTOR</u>	
WEST	0	36	0.34		0	SENS 440 25 0.92 1.08	1093 0
N-E	0	17	0.34		0	LAT 440 82 0.92 0.68	22572
N-W	0	13	0.34	M	0	SUB TOTAL	22504
S-E S-W	0	25 21	0.34	100	0	TOTAL	3350 <u>1</u> 111539
ROOF	1200	51	0.15	0	0		111000
		-			116	HEAT GAIN SAFETY FACTOR @ 3%	3346
OTHER T	RANSMISSIC	ON GAIN		7		GRAND TOTAL HEAT (TONS) 9.6	114885
AGLS	141	25	1.13	Ma.	3996	Ala	
PART	1221	20	0.34	*41 L	8303	A STATE OF THE STA	
CEIL FLOR	1200 1200	20 20	0.34	1	8160 8160	SENSIBLE HEAT FACTOR	0.89
FLOK	1200	20	0.34	1	0100	SELECTED A.D.P. DEHUMIDIFIED RISE	52 20
BYPASS	O.A. SENSIB	LE LOAD					
	<u>CFM</u>	T.DIFF.	FACTOR			DEHUMIDIFIED AIR Cfm	3180
	440	25	0.08	1.08	950	TONS AS PER Cfm	8.0
INTERNA	L SENSIBLE	LOAD				CHECK RESULTS.	
PEOPLE	30	245			7350	GRAND TOTAL HEAT(BTU/HR/SQFT.)	95.74
APPL.	5000	3.4			17000	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	57.93
LIGHTS	1800	3.4		1.25	7650	SQFT/PERSON	40.00
FOOD SUB TOT	0 T/ 55	60			0 63199	TONS PER SQFT CFM PER SQFT	0.01 2.65
300 101	. 33				33133	TONS/PERSON	0.32
LEAK LO	SS +SAFETY I	ACTOR=	5%		3160	DEHUMIDIFIED CFM/TON	332.19
	ENSIBLE HEA				69519	AREA PER TON	125.34

JOB :	GROUND FL	OOR					
	·				·	HEAT LOAD CALCULATIONS	
SPACE:	CIT A					DATE TIME	3/10/2020 18:32
	DESIGN DAT	ГА					
	AREA:				270		
	HT.OF THE				11		
	LIGHTING (V				1.5	HEAT LOAD SUMMARY TR	HP
	NO.OF AIR (REQUIRED		2 99	GRAND TOTAL HEAT 2.3 DEHUMIDIFIED AIR Cfm 745	
	Cfm/PERSO				10	DETICINION TED AIR ON	
	NO.OF PEOI	PLE			10	TONS AS PER Cfm 1.9	
	Cfm VENTIL	ATION			100	TONNAGE REQUIRED 2.3	2.74
	Cfm VENTIL	ATION IN	CAL.		100		
		<u>D.B.</u>	<u>W.B.</u>	<u>%RH</u>	GR/LB	CFM PER SQFT 2.76 AREA PER TON 119	
	OUTSIDE	100 75	83	60 50	146		
	INSIDE DIFF.	75 25		50	64.0 82.0	BCT - BN FF-	
	DIFF.	23		ťΩρ	82.0	LETTER SCHIVE	
	SU	N GAIN	1 60	10	3 16	BYPASS O.A. LATENT LOAD	
		T.DIFF.	FACTOR	200	BTU	<u>CFM</u> <u>G.DIFF</u> <u>BYPASS</u> <u>FACTOR</u>	BTU
			3 .08		F41	100 82 0.08 0.68	446
	GAIN-GLASS		105				
NORTH	26	11	0.56	Store.	158	INTERNAL LATENT LOAD	
SOUTH EAST	0 51	11	0.56	553	0 317	PEOPLE 10 205	2050
WEST	0	165	0.56	25-80	0	SUB TOTAL	2496
N-E	0	11	0.56	1700	0	STRAIL LETTER TO SE	2490
N-W	0	118	0.56	140	0	SAFETY FACTOR=5%	125
S-E	0	11	0.56	155	0	ROOM LATENT HEAT	2621
S-W	0	113	0.56	H	0	MAN I PUIRS IND 2 2 2	
			. 1		HE	ROOM TOTAL HEAT	18903
	R TRANSMISS	-37		- FR	900	OUTSIDE AID USAT	
NORTH SOUTH	130	20 36	0.34 0.34		883	OUTSIDE AIR HEAT	
EAST	181	22	0.34	-	1357	CFM G.DIFF 1-B.F. FACTOR	
WEST	0	36	0.34		0	SENS 100 25 0.92 1.08	2484
N-E	0	17	0.34		0	LAT 100 82 0.92 0.68	5130
N-W	0	13	0.34		0		
S-E	0	25	0.34		0	SUB TOTAL	7614
S-W	0	21	0.34		0	TOTAL	26517
ROOF	270	51	0.15	0	0	HEAT GAIN SAFETY FACTOR @ 3%	796
OTHER T	RANSMISSIO	N GAIN		4		GRAND TOTAL HEAT (TONS) 2.3	27313
AGLS	77	25	1.13	4.	2180		
PART	147	20	0.34	7,01	998	Alon	
CEIL	270	20	0.34	1	1836	SENSIBLE HEAT FACTOR	0.86
FLOR	270	20	0.34	1	1836	SELECTED A.D.P.	52
BYP 4 S S	O.A. SENSIB	IFIOAD				DEHUMIDIFIED RISE	20
A00	CFM	T.DIFF.				DEHUMIDIFIED AIR Cfm	745
	100	25	0.08	1.08	216	TONS AS PER Cfm	1.9
INTERNA	L SENSIBLE	LOAD				CHECK RESULTS.	
PEOPLE	10	245			2450	GRAND TOTAL HEAT(BTU/HR/SQFT.)	101.16
APPL,	250	3.4		4.0-	850	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	60.30
LIGHTS	405 0	3.4		1.25	1721 0	SQFT/PERSON TONS BED SOFT	27.00
FOOD SUB TOT		60			0 14802	TONS PER SQFT CFM PER SQFT	0.01 2.76
202 101					1-1002	TONS/PERSON	0.23
LEAK LO	SS +SAFETY F	ACTOR=5	5%		740	DEHUMIDIFIED CFM/TON	327.26
	ENSIBLE HEA				16282	AREA PER TON	118.63

JOB :	GROUND F	LOOR					
						HEAT LOAD CALCULATIONS	
SPACE:	AO AND PS	5A				DATE TIME	3/10/2020 18:32
	DESIGN DA	TA					
	AREA:	<u> </u>			240		
	HT.OF THE				11		
	LIGHTING (•		1.5	HEAT LOAD SUMMARY TR	HP
	NO.OF AIR		REQUIRED)	2 88	GRAND TOTAL HEAT 1.9	
	Cfm/PERSC				10	DEHUMIDIFIED AIR Cfm 602	
	NO.OF PEO				6	TONS AS PER Cfm 1.5	
	Cfm VENTII	LATION			60	TONNAGE REQUIRED 1.9	2.23
	Cfm VENTII	LATION IN	I CAL.		88		
						CFM PER SQFT 2.51	
	OUTSIDE	D.B.	W.B.	<u>%RH</u>	GR/LB	AREA PER TON 130	
	OUTSIDE	100 75	83	60 50	146 64.0		
	DIFF.	25		30	82.0	PERLITOR TECH	
			-	433		PHILIPPIN SCHAL	
	Si	UN GAIN	-1 6	4	1	BYPASS O.A. LATENT LOAD	
	_	r T.DIFF.	FACTOR	6932	BTU	CFM G.DIFF BYPASS FACTOR	BTU
				64.	111	88 82 0.08 0.68	393
	AIN-GLASS	200	155			12 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
NORTH	0	11	0.56		0	INTERNAL LATENT LOAD	
SOUTH	0	11	0.56	853	0	PEOPLE 6 205	1230
EAST	51	11	0.56	300	317		
WEST	0	165	0.56	17/2	0	SUB TOTAL	1623
N-E	0	11 118	0.56	163	0	S ALEXANDER OF THE SECOND STATE OF THE SECOND	04
N-W S-E	0	110	0.56 0.56	- 13	0	SAFETY FACTOR=5% ROOM LATENT HEAT	81 1704
S-W	0	113	0.56	- 90	0	ROOM EXTERVINEAT	1704
						ROOM TOTAL HEAT	14857
SOLAR &	TRANSMIS	SION GAI	N	- 154	1111	THE LETTER IN 18 18 18 18 18 18 18 18 18 18 18 18 18	
NORTH	0	20	0.34	- 111	0	OUTSIDE AIR HEAT	
SOUTH	0	36	0.34	- 111	0	11	
EAST	153	22	0.34		1146	CFM G.DIFF 1-B.F. FACTOR	0400
WEST N-E	0	36 17	0.34 0.34		0	SENS 88 25 0.92 1.08 LAT 88 82 0.92 0.68	2186 4514
N-W	0	13	0.34		0	LA1 86 62 0.92 0.06	4514
S-E	0	25	0.34	ш -	0	SUB TOTAL	6700
S-W	0	21	0.34		0	TOTAL	21557
ROOF	240	51	0.15	0	0		
						HEAT GAIN SAFETY FACTOR @ 3%	647
OTHER T	RANSMISSI	ON GAIN		4.	-	GRAND TOTAL HEAT (TONS) 1.9	22204
AGLS	51	25	1.13	NA.	1453	Alm	
PART	131	20	0.34	- 4	888	Company News Control	
CEIL	240	20	0.34	1	1632	SENSIBLE HEAT FACTOR	0.89
FLOR	240	20	0.34	1	1632	SELECTED A.D.P. DEHUMIDIFIED RISE	52 20
BYPASS	O.A. SENSIE	BLE LOAD					20
	<u>CFM</u>	T.DIFF.	FACTOR			DEHUMIDIFIED AIR Cfm	602
	88	25	0.08	1.08	190	TONS AS PER Cfm	1.5
INTERNA	L SENSIBLE	LOAD				CHECK RESULTS.	
PEOPLE	6	245			1470	GRAND TOTAL HEAT(BTU/HR/SQFT.)	92.52
APPL.	500	3.4			1700	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	54.81
LIGHTS	360	3.4		1.25	1530	SQFT/PERSON	40.00
FOOD	0	60			0	TONS PER SQFT	0.01
SUB TOT	AL				11958	CFM PER SQFT	2.51
						TONS/PERSON	0.31
	SS +SAFETY		5%		598	DEHUMIDIFIED CFM/TON	325.20
KOOM SE	ENSIBLE HE	A I			13153	AREA PER TON	129.71

JOB :	GROUND FI	_OOR										
										AD CALCU	LATIONS	
SPACE:	JCTI - 1								OATE TIME			3/10/2020 18:32
	DESIGN DA	TA						L				
	AREA:				290							
	HT.OF THE	AREA:			11							
	LIGHTING (WATTS/S	QFT)		1.5		HEAT LOAD				TR	HP
	NO.OF AIR		REQUIRED		2		GRAND TO				2.5	
	Cfm VENTIL				106		DEHUMIDIF	IED AIR C	fm		832	
	Cfm/PERSC				10 10		TONS AS P	ED Cfm			2.1	
	Cfm VENTIL				100		TONNAGE F				2.1	2.99
	Cfm VENTIL		I CAL.		106	1	TOMINAGET	(Locolitica			2.0	2.33
						Lamon	CFM PER S	QFT			2.87	
		D.B.	W.B.	%RH	GR/LB		AREA PER T	ON			117	
	OUTSIDE	100	83	60	146	Cot is	120					
	INSIDE	75	-	50	64.0	1000000	KN 7	200				
	DIFF.	25	-	- 43	82.0	(EEL-Last	HI3. 1	EFz	8.			
			1. 1	CAN		T. Little	1174	7,547	Also			
		n. C. n.	- 100	10	3-51	[pym+00	0.4.1.475317		244			
	· ·	UN GAIN	ELCTOD	1500	DTU		O.A. LATENT		CDEE	DVD 4 CC	E4 CEOD	DTU
	AREA 01	r T.DIFF.	FACTOR	 	BTU			<u>CFM</u> 106	G.DIFF 82	BYPASS 0.08	0.68	<u>BTU</u> 474
SOLAR G	AIN-GLASS	100	1,000			H-Tabel I		100	02	0.00	0.00	4/4
NORTH	0	11	0.56		0	INTERNA	L LATENT LO	DAD		162	4	
SOUTH	30	11	0.56	DR	187	PEOPLE	1 200	10	205	45	70%	2050
EAST	51	11	0.56	039	317			1		- 90.	20	
WEST	0	165	0.56	15-77	0	SUB TO	ΓAL					2524
N-E	0	11	0.56	420	0		EAST	1977			200	
N-W	0	118	0.56	- 64	0	SAFETY	FACTOR=5%	100			200	126
S-E	0	11	0.56	- F0:	0	ROOM L	ATENT HEAT				-	2651
S-W	0	113	0.56	- 144	0	CHILL	THU.	Dr. Sky				
	-	775				ROOM T	OTAL HEAT				100	20832
SOLAR &	TRANSMISS	SION GAIL	N	- 155	шш		16.677	740				
NORTH	0	20	0.34	- 111	0	OUTSIDE	AIR HEAT	-	_		100	
SOUTH	161	36	0.34	- 1.1.1	1975						4.00	
EAST	144	22	0.34		1074			CFM	G.DIFF		FACTOR	
WEST	0	36	0.34		0	SENS		106	25	0.92	1.08	2641
N-E	0	17	0.34		0	LAT		106	82	0.92	0.68	5455
N-W S-E	0	13 25	0.34 0.34		0	SUB TO	rai.				279	8096
S-E S-W	0	21	0.34		0	TOTAL	AL		_		~	28928
ROOF	290	51	0.15	0	0	IOTAL						20320
ROOF	250	31	0.13			HEAT GA	AIN SAFETY F	ACTOR	@ 3%			868
									0,0			
OTHER T	RANSMISSIC	ON GAIN			Profit I	GRAND 1	TOTAL HEAT			(TONS)	2.5	29796
AGLS	82	25	1.13	Ma.	2311			100	De .			
PART	197	20	0.34	141	1342			W 11	100			
CEIL	290	20	0.34	1	1972	SENSIBL	E HEAT FAC	TOR				0.87
FLOR	290	20	0.34	1	1972	SELECTI	ED A.D.P.					52
						DEHUMII	DIFIED RISE					20
BYPASS	O.A. SENSIE											
	<u>CFM</u>		FACTOR				DIFIED AIR C	m				832
	106	25	0.08	1.08	230	TONS AS	S PER Cfm					2.1
INTERNA	L SENSIBLE	LOAD				CHECK	RESULTS.					
PEOPLE	10	245			2450		TOTAL HEAT(I	RTI/HD/C	OEL)			102.74
APPL.	250	3.4			850		ENSIBLE HEAT					62.69
LIGHTS	435	3.4		1.25	1849	SQFT/PE		·(DIO/IK	3QF1.)			29.00
FOOD	0	60		25	0	TONS PE						0.01
SUB TOT					16528	CFM PER						2.87
						TONS/PE	-					0.25
LEAK LOS	SS +SAFETY I	FACTOR=	5%		826		DIFIED CFM/TO	ON				334.98
		AT .			18181	AREA PE						116.80

	ADDL JCTI -		· <u> </u>		_	l	
		1				HEAT LOAD CALCULATIONS DATE	3/10/2020
[TIME	18:32
<u> </u>	DESIGN DAT	Α					
	AREA:				270		
	HT.OF THE A LIGHTING (V		OET)		11 1.5	HEAT LOAD SUMMARY TR	НР
	NO.OF AIR (•		2	GRAND TOTAL HEAT 2.1	nr
	Cfm VENTIL				99	DEHUMIDIFIED AIR Cfm 660	
	Cfm/PERSOI				10		
	NO.OF PEOF				10	TONS AS PER Cfm 1.6	0.55
	Cfm VENTIL		I CAL		100 100	TONNAGE REQUIRED 2.1	2.55
•	OIIII VEIVITE	ATTOTAL	· OAL.			CFM PER SQFT 2.44	
		D.B.	W.B.	%RH	GR/LB	AREA PER TON 128	
	OUTSIDE	100	83	60	146		
	INSIDE DIFF.	75 25	-	50	64.0 82.0	CH-KN PP-	
L	DIFF.	23		100	62.0	HINTER SCALE	
			4.30	200	1.0	CONTRACT TO THE PARTY OF THE PA	
	SU	N GAIN	7.60	200		BYPASS O.A. LATENT LOAD	
	AREA or	T.DIFF.	FACTOR	92"	BTU	<u>CFM</u> <u>G.DIFF</u> <u>BYPASS</u> <u>FACTOR</u>	BT U
SOLAR C	AIN-GLASS	-51	3 722		+11	100 82 0.08 0.68	446
NORTH	0	11	0.56		0	INTERNAL LATENT LOAD	
SOUTH	38	11	0.56	Tire	237	PEOPLE 10 205	2050
EAST	0	11	0.56	(25) E	0		
WEST	0	165	0.56	10 25	0	SUB TOTAL	2496
N-E	0	11	0.56	723	0		
N-W	0	118	0.56	100	0	SAFETY FACTOR=5%	125
S-E	0	11	0.56	- F133	0	ROOM LATENT HEAT	2621
S-W	0	113	0.56	1711	0	ROOM TOTAL HEAT	17040
SOLAR &	TRANSMISS	ION GAI	N	HIII		INCOM TOTAL TILAT	17040
NORTH	0	20	0.34		0	OUTSIDE AIR HEAT	
SOUTH	126	36	0.34		1536	7 110770011117	
EAST	0	22	0.34		0	<u>CFM</u> <u>G.DIFF</u> <u>1-B.F.</u> <u>FACTOR</u>	
WEST	0	36	0.34		0	SENS 100 25 0.92 1.08	2484
N-E N-W	0	17 13	0.34		0	LAT 100 82 0.92 0.68	5130
S-E	0	25	0.34	1	0	SUB TOTAL	7614
S-W	0	21	0.34		0	TOTAL	24654
ROOF	270	51	0.15	0	0		
						HEAT GAIN SAFETY FACTOR @ 3%	740
OTHER TR	RANSMISSIO	N GAIN			79	GRAND TOTAL HEAT (TONS) 2.1	25394
AGLS	38	25	1.13	4.	1085	11.	
PART	197	20	0.34	141	1342	with the	
CEIL	270	20	0.34	1	1836	SENSIBLE HEAT FACTOR	0.85
FLOR	270	20	0.34	1	1836	SELECTED A.D.P. DEHUMIDIFIED RISE	52 20
BYPASS (O.A. SENSIBI	LE LOAD)				20
			FACTOR			DEHUMIDIFIED AIR Cfm	660
	100	25	0.08	1.08	216	TONS AS PER Cfm	1.6
INTERNAL	SENSIBLE I	ΟΔΡ				CHECK RESULTS.	
PEOPLE	10	245			2450	GRAND TOTAL HEAT(BTU/HR/SQFT.)	94.05
APPL.	250	3.4			850	ROOM SENS IBLE HEAT (BTU/HR/SQFT.)	53.41
LIGHTS	405	3.4		1.25	1721	SQFT/PERSON	27.00
FOOD	0	60			0	TONS PER SQFT	0.01
SUB TOTA	AL				13109	CFM PER SQFT	2.44
	10 10 1 ETETET	LOTOR	5 0/			TONS/PERSON	0.21
	S +SAFETY F	ACTOR=	5%		655 14419	DEHUMIDIFIED CFM/TON AREA PER TON	311.72 127.59

JOB :	GROUND FL	OOR.				HEAT LOAD ON ATTOM	
SPACE:	CIT (B)					HEAT LOAD CALCULATIONS DATE TIME	3/10/2020 18:32
	DESIGN DAT				270		
	HT.OF THE		SOET)		11 1.5	HEAT LOAD SUMMARY TR	HF
	NO.OF AIR				2	GRAND TOTAL HEAT 2.3	пг
	Cfm VENTIL				99	DEHUMIDIFIED AIR Cfm 746	
	Cfm/PERSO	N			10		
	NO.OF PEO	PLE			10	TONS AS PER Cfm 1.9	
	Cfm VENTIL				100	TONNAGE REQUIRED 2.3	2.75
	Cfm VENTIL	ATION I	N CAL.		100	CFM PER SQFT 2.76	
		D.B.	W.B.	%RH	GR/LB	CFM PER SQFT 2.76 AREA PER TON 118	
	OUTSIDE	100	83	60	146	AREATER TON 110	
	INSIDE	75		50	64.0	34° 340	
	DIFF.	25		48	82.0	ELDING IFF.	
			1	C)UP	100	THE PARTY OF THE PARTY.	
	er:	N CAB	1. 163	1	-	PYPASS O A LATENT LOAD	
		N GAIN	FACTOR	2720	BTU	BYPASS O.A. LATENT LOAD CFM GDIFF BYPASS FACTOR	BTU
	ANIA UL	1.0111.	-11010		210	100 82 0.08 0.68	446
SOLAR G	GAIN-GLASS	35	1080			LINES OF CO	
NORTH	0	11	0.56		0	INTERNAL LATENT LOAD	
SOUTH	34	11	0.56	52.7	210	PEOPLE 10 205	2050
EAST	0	11	0.56	900	0	Statistical Control	
WEST	0	165	0.56	Res	0	SUB TOTAL	2496
N-E	0	11	0.56	760	0	어딘 [1 1822] [1 11 12 13 2 2 2 2 2	
N-W	0	118	0.56	- 835	0	SAFETY FACTOR=5%	125
S-E S-W	0	113	0.56 0.56	DR	0	ROOM LATENT HEAT	2621
5-44		113	0.50			ROOM TOTAL HEAT	18937
SOLAR 8	R TRANSMISS	ION GA	IN	- 154	1101	Z7794U	
NORTH	0	20	0.34	-111	0	OUTSIDE AIR HEAT	
SOUTH	153	36	0.34	11.11	1876	1	
EAST	0	22	0.34		0	CFM G.DIFF 1-B.F. FACTOR	0.40
WEST	79	36	0.34		963	SENS 100 25 0.92 1.08 LAT 100 82 0.92 0.68	2484
N-E N-W	0	17 13	0.34		0	LAT 100 82 0.92 0.68	5130
S-E	0	25	0.34		0	SUB TOTAL	7614
S-W	0	21	0.34		0	TOTAL	26550
ROOF	270	51	0.15	0	0		
					1	HEAT GAIN SAFETY FACTOR @ 3%	797
OTHER T	RANSMISSIO	N GAIN				GRAND TOTAL HEAT (TONS) 2.3	27347
AGLS	34	25		W.	965	(1010) 23	21041
PART	281	20		7,01	1909	AIDIN.	
CEIL	270	20	0.34	1	1836	SENSIBLE HEAT FACTOR	0.86
FLOR	270	20	0.34	1	1836	SELECTED A.D.P.	52
						DEHUMIDIFIED RISE	20
BYPASS	O.A. SENSIB		FACTOR			DEHUMIDIFIED AIR Cfm	746
	<u>CFM</u> 100	25	0.08	1.08	216	TONS AS PER Cfm	1.9
	L SENSIBLE					CHECK RESULTS.	
PEOPLE	10	245			2450	GRAND TOTAL HEAT(BTU/HR/SQFT.)	101.29
APPL.	250 405	3.4		4.05	850 4734	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	60.43
LIGHTS	405 0	3.4 60		1.25	1721 0	SQFT/PERSON TONS DED SOFT	27.00
FOOD SUB TOT		60			14832	TONS PER SQFT CFM PER SQFT	0.01 2.76
202 101					1-1032	TONS/PERSON	0.23
LEAK LO	SS +SAFETY F	ACTOR=	=5%		742	DEHUMIDIFIED CFM/TON	327.52
	ENSIBLE HEA				16316	AREA PER TON	118.48

JOB :	GROUND FLO	OR				UFAT LOAD OALOW ATIONS	
SDACE .	AO AND DO (2)				HEAT LOAD CALCULATIONS DATE 3	3/10/2020
SPACE :	AO AND PS (E	3)				TIME	18:32
	DESIGN DATA	A				<u> </u>	
	AREA:				210		
	HT.OF THE AI		DOET)		11	LIEAT LOAD CHMMADY TD	
	NO.OF AIR CH)	1.5 2	HEAT LOAD SUMMARY TR GRAND TOTAL HEAT 1.3	HP
	Cfm VENTILA		. IVEQUIVEE	,	77	DEHUMIDIFIED AIR Cfm 399	
	Cfm/PERSON				10		
	NO.OF PEOPI	LE			2	TONS AS PER Cfm 1.0	
	Cfm VENTILA				20	TONNAGE REQUIRED 1.3	1.59
	Cfm VENTILA	TION	N CAL.		77	OFW DED COST	
		D.B.	W.B.	%RH	GR/LB	CFM PER SQFT 1.90 AREA PER TON 159	
	OUTSIDE	100	83	60	146	AREATER TON 139	
	INSIDE	75		50	64.0		
	DIFF.	25			82.0	M31-35 Pr-	
				CK.F	120	Phittle CHA.	
	SUN	GAIN	1800	15.5		BYPASS O.A. LATENT LOAD	
	AREA or T		FACTOR	a,	BTU	CFM G.DIFF BYPASS FACTOR	BTU
		Æ	* ASS		651	77 82 0.08 0.68	343
SOLAR C	GAIN-GLASS		1900			PULLINE SOC	
NORTH	0	11	0.56		0	INTERNAL LATENT LOAD	
SOUTH	0	11	0.56	Digo	0	PEOPLE 2 205	410
EAST	0	11	0.56	4342	0	255 LUNNY () 5.54	
WEST	0	165	0.56	525	0	SUB TOTAL	753
N-E N-W	0	11 118	0.56 0.56		0	SAFETY FACTOR-59/	20
N-W S-E	0	118	0.56	1997	0	SAFETY FACTOR=5% ROOM LATENT HEAT	38 791
S-W	0	113	0.56	1631	0	ROOM EATENT HEAT	731
5-11	1 2	110	0.00	1891		ROOM TOTAL HEAT	9522
SOLAR 8	R TRANSMISSI	ON GA	IN	ши		的 11万头加下了好 云龙	
NORTH	0	20	0.34	mil	0	OUTSIDE AIR HEAT	
SOUTH	0	36	0.34		0	15 NOON 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
EAST	0	22	0.34		0	<u>CFM G.DIFF 1-B.F. FACTOR</u>	
WEST	0	36	0.34		0	SENS 77 25 0.92 1.08	1913
N-E	0	17	0.34		0	LAT 77 82 0.92 0.68	3950
N-W	0	13	0.34		0		
S-E	0	25	0.34		0	SUB TOTAL	5863
S-W ROOF	0 210	21 51	0.34 0.15	0	0	TOTAL	15385
ROOF	210	51	0.15	Ů	Ů	HEAT GAIN SAFETY FACTOR @ 3%	462
OTHER T	RANSMISSION	I GAIN		W . []	h.	GRAND TOTAL HEAT (TONS) 1.3	15846
AGLS	0	25	1.13		0	CICARD TOTAL TILAT (TORO) 1.3	13040
PART	204	20	0.34	Mi.	1386	Alm	
CEIL	210	20	0.34	4 1	1428	SENSIBLE HEAT FACTOR	0.92
FLOR	210	20	0.34	1	1428	SELECTED A.D.P.	52
						DEHUMIDIFIED RISE	20
BYPASS	O.A. SENSIBL						
	·		FACTOR			DEHUMIDIFIED AIR Cfm	399
	77	25	0.08	1.08	166	TONS AS PER Cfm	1.0
INTERNA	AL SENSIBLE L	OAD				CHECK RESULTS.	
PEOPLE	2	245			490	GRAND TOTAL HEAT(BTU/HR/SQFT.)	75.46
APPL.	500	3.4			1700	ROOM SENSIBLE HEAT(BTU/HR/SQFT.)	41.58
LIGHTS	315	3.4		1.25	1339	SQFT/PERSON	105.00
FOOD	0	60			0	TONS PER SQFT	0.01
SUB TOT	ΓAL				7937	CFM PER SQFT	1.90
						TONS/PERSON	0.66
	SS +SAFETY FA		=5%		397	DEHUMIDIFIED CFM/TON	302.47
ROOM S	ENSIBLE HEAT	•			8731	AREA PER TON	159.03

		SU	BJECT : HEA	AT LOAD	SUMMARY	SHEET								
	PROJECT:	INCOME TAX OFFICE GROUND FLOOR												
SR.	DISCRIPTION	Area	Occupancy	WATTS	Fresh air	APPL.	Dehumidified	Tonnage	Cfm/Hp	Tonnage				
		Sq.ft.	Nos.	Sq.ft.	CFM	WATTS.	air	REQ. (TR)		HP				
1	STAFF AREA - 1	1400	30	1.5	513	5000	3314	10.3	13.3	12.5				
2	DCIT - 1	200	7	1.5	73	250	398	1.4	1.6	1.7				
3	DCIT-2	200	7	1.5	73	250	398	1.4	1.6	1.7				
4	ПО - 1	190	6	2	70	250	545	1.6	2.2	1.9				
5	ITO - 2	190	6	2	70	250	413	1.4	1.7	1.7				
6	ПО - 3	190	6	2	70	250	507	1.5	2.0	1.9				
7	ПО - 4	190	6	2	70	250	530	1.6	2.1	1.9				
8	STAFF AREA - 2	1200	30	2	440	5000	3180	9.6	12.7	11.5				
9	СГГА	270	10	2	100	250	745	2.3	3.0	2.7				
10	AO AND PSA	240	6	2	88	500	602	1.9	2.4	2.2				
11	JCTI-1	290	10	2	106	250	832	2.5	3.3	3.0				
12	ADDL JCTI - 1	270	10	2	100	250	660	2.1	2.6	2.5				
13	CIT (B)	270	10	2	100	250	746	2.3	3.0	2.7				
14	AO AND PS (B)	210	2	2	77	500	399	1.3	1.6	1.6				
	TOTAL	5310	146	21	1950	13500	13271	41	53	50				



CHAPTER 08

8. PHOTOGRAPHY:



Figure 8-1. Project visit with staff



Figure 8-2. Outdoor Unit



Figure 8-3 ODU

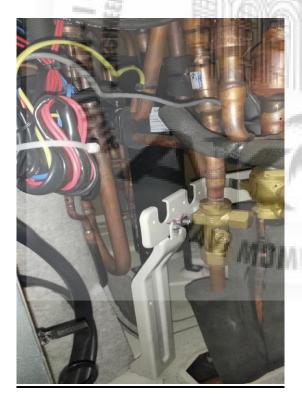


Figure 8-5. Component of ODU



Figure 8-4 Raffinates



Figure 8-6.Cassette





Figure 8-7.IDU Cassette

Figure 8-8.Scroll Compressor



Figure 8-9.False Ceiling for IDU Installation



Figure 8-10. Inventory



Figure 8-11. Grill of IDU

CHAPTER 09

9. FUTURE SCOPE & CONCLUSION

9.1. Future Scope:

A new refrigerant detection and management system works with VRF (Variable Refrigerant Flow) air conditioning systems. In the unlikely event of a refrigerant leak, it shuts down the specific section of pipework involved, while enabling the rest of the system to continue operating as normal.

The VRF systems that are out today will undoubtedly be improved as the popularity of this system continues to increase and competition exists between manufacturers to produce the best product. In the meantime, it is best to study the operating principles of what's already out there so that the performance of these installed systems can be optimized through proper design, installation and commissioning.

The overall efficiency, design flexibility, and total life cycle cost of variable refrigerant flow (VRF) systems are driving growth of the technology in the HVAC market. Such growth is evidenced by a recent report from Markets and Markets, which reports the global VRF market is projected to reach approximately \$9.65 billion by 2021, registering a compound annual growth rate (CAGR) of 10.8 percent between 2016 and 2021.

We should get better efficient system by calculating heat & cooling load on TOSHIBA SMMS7 software. This software is fully automated due to which we can calculating heat load of complicate space easily. We will also be using Carrier HAP software for the calculating the heat & cooling load which is fully automated.

9.2. Conclusion:

The VRF system has been designed successfully considering the required indoor condition. proper pipe dimensions and material has been selected. indoor and outdoor units as per requirement are selected.



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