ASHRAE (American Society of Heating Refrigerating and Air Conditioning Engineers) is a global professional association seeking to advance HVAC & R system design and construction. It has more than 50000 members worldwide, composed of building service engineers, mechanical contractors, architects, building owners, equipment manufacturers and all others concerned with design and construction of HVAC & R systems in the buildings. The society funds research projects, offers continuing education programs, develops and publishes technical standards to improve energy efficiency, indoor air quality and sustainable development.

MKSSS’s Cummins College of Engineering for Women, Pune ASHRAE student branch was established in January 2022. It has currently twenty-nine student members. Prof. Dr. Parag Chaware and Prof. Rujuta Agavekar are the faculty Advisors for the student branch.

List of the Activities

Sr. No.	Name of the Event	Date
1	Industrial visit to Persistent Systems, Ramanujan	August 24, 2024
2	Industrial Visit to Deenanath Mangeshkar Hospital	November 16, 2024
3	Industrial visit to Kirloskar Pneumatics Company Ltd	February 20, 2025
4	Industrial visit to Indian Institute of Tropical Meteorology (IITM)	March 11, 2025
5	Industrial Visit to Yashwantrao Chavan Natyagruha	April 22, 2025

Persistent Systems, Ramanujan Industrial Visit

Report

Day and Date: - Saturday, August 24, 2024

Name of Company –Ramanujan Persistent Systems, Ramanujan

Location of Visit - Hinjewadi, Pune

Duration - 2 hours

Participants -

- students from Second and Third Year, Mechanical Department, (ASHRAE Members)
- Prof. Rujuta Agavekar, SBA
- Prof. Parag Chaware, SBA

1. Introduction

Persistent Systems is established in 1990, specializing in IT services, cloud computing, and data analytics. Industries served are as follows. Healthcare, Banking, Telecommunications, AI & IoT.

The HVAC system at Ramanujan Persistent, Hinjewadi, Pune, is a highly efficient and technologically advanced setup designed to provide optimal indoor air quality and thermal comfort. Given the nature of Persistent Systems' operations, which involve IT infrastructure, data analytics, and cloud computing, maintaining a controlled environment is crucial. This report details the design specifications, system components, filtration, airflow, energy efficiency, and safety measures incorporated into the facility's HVAC system.

2. System Overview

The HVAC system is structured to provide cooling, ventilation, and humidity control through a Variable Refrigerant Flow (VRF) system, which ensures precise temperature regulation, energy efficiency, and flexibility in operation.

2.1 VRF System: The primary cooling solution for the building, allowing independent temperature control for different zones.

2.2 Ducted Fresh Air Supply: Ensures proper ventilation and indoor air quality by supplying fresh air into the workspace.

2.3 Demand-Controlled Ventilation (DCV): Adjusts fresh air supply based on CO_2 levels to enhance energy efficiency.

3 Cooling Capacity & Design Conditions

The HVAC system operates under the following design parameters:

3.1 Cooling Load: The system is designed to handle multiple zones with varying cooling loads.

3.2 Temperature and Humidity Control: Indoor temperature is maintained at 22°C and relative humidity at 50%

3.3 Thermal Load Consideration: Structural heat radiation and Human occupancy and heat load from electrical equipment

4 Filtration & Air Quality Management

Ensuring high indoor air quality is a key component of the HVAC design at Persistent.

The system is equipped with:

4.1 MERV 13 Filters:

- Two-stage filtration system
- Efficiency: Captures 3-micron and 10-micron particulate matter

4.2 Fresh Air Intake:

- Ducted fresh air system
- Demand control ventilation (CO_2-based) to optimize fresh air intake

4.3 Airflow Rate: Each unit operates at 500 CFM (Cubic Feet per Minute)

4.4 Exhaust and Ventilation System:

- Dedicated exhaust systems for server rooms and high-heat zones
- Negative pressure zones for controlled airflow

5 Airflow & Distribution Mechanism

5.1 Variable Refrigerant Flow (VRF) System:

- Provides efficient cooling with zonal control
- Adjusts refrigerant flow based on real-time load demand

5.2 Zonal Cooling Strategy:

- Multiple cooling zones to cater to different operational areas
- Independent control for IT server rooms, workstations, and meeting rooms

6 Safety & Protection Measures

6.1 Fire & Smoke Protection:

- HVAC system integrated with fire suppression and alarm systems
- Smoke dampers in ductwork to prevent smoke spread

6.2 PCB (Printed Circuit Board) Protection:

Metal-encased PCBs to prevent short circuits and overheating issues

6.3 Emergency Ventilation Protocols:

- Automatic shutdown of HVAC system in case of fire detection
- Dedicated exhaust for hazardous areas

7 Learning Outcomes:

During the site visit at Persistent Systems, the following insights were gathered:

7.1 HVAC Integration with IT Infrastructure:

- The facility has a VRF system designed to handle high server loads.
- Smart sensors regulate airflow and temperature based on occupancy.
- AI-driven HVAC management for predictive maintenance and efficiency.

7.2 Sustainability Focus:

- Heavy reliance on renewable energy sources
- Smart building automation for energy conservation

8 Conclusion

The HVAC system at Ramanujan Persistent, Hinjewadi, Pune, is a well-optimized and energy-efficient setup that integrates modern cooling technologies, air quality management, and renewable energy sources. The system ensures a comfortable and safe indoor environment while prioritizing sustainability and operational efficiency. With demand-controlled ventilation, high-efficiency VRF technology, and smart automation, the facility meets the high standards required for IT infrastructure and corporate office spaces.

Compiled by: Vaishnavi Patil
Tisha Bias
Mital Paratane

Deenanath Mangeshkar Hospital

Industrial Visit

Report

Name of Place: – Deenanath Mangeshkar Hospital, Pune

Day and Date: - Saturday, November 16, 2024

Duration - 4 hours

Participants 22 students of SY and TY Mechanical Department (ASHRAE Members)

Prof. Rujuta Agavekar, SBA

1. Introduction

On November 16, 2024, members of the ASHRAE student chapter visited Deenanath Mangeshkar Hospital to study the natural gas-based power generation system and the Vapor Absorption Refrigeration System (VARS) implemented at the hospital. The visit aimed to understand the working principles, energy efficiency measures, and practical applications of these technologies.

2. Overview of the System

The energy generation system at Deenanath Mangeshkar Hospital is designed to operate entirely on a pressurized Natural Gas (PNG) pipeline. This system is highly efficient and eco-friendly, utilizing natural gas as the sole fuel source to power engines that generate electricity. One of the most remarkable aspects of this setup is that the hospital functions independently of the conventional electricity grid. As a result, it incurs no electricity bills, providing substantial cost savings.

The setup achieves greater energy efficiency by eliminating the need for compressors, which are typically associated with higher energy consumption. As the natural gas engines operate, water circulates through the engine jackets, absorbing heat and raising its temperature to approximately 90°C. Engine jacket water and exhaust gases are used as heat input to the vapor absorption refrigeration system.

3. Vapor Absorption Refrigeration System (VARS)

The Vapor Absorption Refrigeration System (VARS) is a type of refrigeration technology that uses a heat source to provide cooling, rather than relying on electrical energy directly. Unlike conventional vapor compression systems, VARS uses a thermochemical process involving a refrigerant and an absorbent, making it an energy-efficient and environmentally friendly alternative for air conditioning and refrigeration applications.

In the system implemented at Deenanath Mangeshkar Hospital, natural gas combustion produces exhaust gases at high temperatures (450-500°C), which are then utilized to drive the VARS process. The system uses Lithium Bromide (LiBr) as the absorbent and water as the refrigerant. The absorption of refrigerant vapor by the absorbent occurs at low pressure and temperature, enabling effective cooling.

The VARS is utilized for cooling by reclaiming exhaust gases from the natural gas combustion process. The major components of the VARS include:
The major components of the VARS include:

- **Generator**: Where heat from exhaust gases is used to separate refrigerant vapor from the absorbent solution.
- **Condenser:** Cools and condenses the refrigerant vapor to liquid form.
- **Absorber:** Where refrigerant vapor is absorbed back into the absorbent solution under vacuum conditions.
- **Evaporator:** Produces the desired cooling effect by allowing the refrigerant to evaporate at low pressure.

The generator and condenser are present on the top cylindrical drum, whereas the absorber and evaporator are in the lower cylindrical drum below. The absorber and evaporator are maintained at a severe vacuum. Exhaust gases from combustion, reaching temperatures of 450-500°C, are utilized to heat a salt and water solution (Lithium Bromide - LiBr).

In the shell and tube condenser operating at 50°C, the water vapor produced in the generator is condensed by releasing latent heat to a cooling medium, typically water. After condensation, the resulting liquid is throttled, causing a sudden drop in pressure and temperature to approximately 2°C.

The low temperature required for this phase change is achieved by maintaining the absorber and evaporator under a high vacuum (near-absolute vacuum conditions of around 0 to 6 mmHg). This vacuum lowers the boiling point of the refrigerant, facilitating its evaporation at lower temperatures. The Lithium Bromide (LiBr) salt solution acts as a highly effective absorbent due to its strong chemical affinity toward water vapor. As the refrigerant vapor enters the absorber, it is readily absorbed by the LiBr solution, forming a dilute solution that is then pumped back to the generator for regeneration, completing the absorption refrigeration cycle.

4. Air Handling Unit (AHU)

It consists of air filters, chilled water coil and centrifugal blowers. Chilled water from evaporator at 6°C is circulated through the cooling coil. It absorbs heat from the air from the application zone and its temperature is raised to 13-14°C. This water returns to evaporator where it is then re-cooled to 6°C by spraying 2°C refrigerant water over the coils. The AHU receives 200 m^3 of air per hour, performing 15-20 air changes per hour. Air at 20-25°C enters a shell and tube heat exchanger where chilled water cools it before passing through a mixing chamber and filtration system. The final supply temperature to areas like operation theatres is maintained at 18°C. Nitride rubber insulation is provided wherever necessary.

5. System Performance and Output

- The vapor absorption cycle provides a cooling capacity of **350 TR (Tons of Refrigeration)**.
- Machines used are manufactured by **Thermax**.
- Approximately 8 **lakh units of electricity is generated per month**
- The engine generates **800 kW of energy** at a load of **67%**.

Photographs:

6. Conclusion

The industrial visit to Deenanath Mangeshkar Hospital provided valuable insights into the use of natural gas as a clean energy source for power generation and cooling. The Vapor Absorption Refrigeration System, with its heat recovery mechanism, offers a highly efficient and eco-friendly solution to energy management. The visit highlighted the importance of energy conservation through technological advancements and innovative engineering practices.

Kirloskar Pneumatic Company Limited - Industrial Visit

Report

Day & Date - Wednesday, February 20, 2025

Name of company - Kirloskar Pneumatic Limited, Pune
Duration - 5 hours

Number of Participants

- 23 Students of Second Year and Third Year, Mechanical Engineering Department, (ASHRAE Members)
- Prof. Rujuta Agavekar, SBA

1. Introduction

Kirloskar Pneumatic Limited (KPCL) has a rich history, established in 1958, and carries a legacy of over 135 years. The company's core focus revolves around maintaining high quality, achieving sustainable global growth, and ensuring operational speed. A key figure in KPCL's foundation is Shri Lakshmanrao Kirloskar. KPCL prides itself on a strong employment record. The company's operations are spread across multiple branches, including those in Hadapsar, Saswad, and Nashik. KPCL's manufacturing capabilities are primarily centered on:

- Air Compressors
- Processing Gas Systems
- Transmissions

2. **Plant Operations: A Detailed Overview - The industrial visit offered an in-depth look at the various operational sections within the KPCL plant:**

2.1 Receipt Section: This is the initial stage where the quality of incoming components is meticulously verified. The plant employs IOT-enabled machines to aid in the inspection process. To ensure operational efficiency, the section utilizes tools and methodologies such as 5S, kaizen, and poka-yoke.

2.2 Store Section: This section is crucial for managing stress-related prosthetic processes, with a key focus on relieving. Relieving is particularly important to mitigate issues that arise from welding during the manufacturing of components. The relieving process involves a 4-hour cycle of soaking and cooling. It is noteworthy that the components used by KPCL are fabricated rather than forged. The cylindricity of components is rigorously checked before they are sent for further processing. These processes are specifically applied to refrigeration compressors.

2.3 Pressure Testing Process: A critical step to ensure product integrity, this process is designed to detect any leakages in the manufactured components. Leakages are visually identified by the formation of bubbles. The testing is conducted at a pressure of 21 kg. The pressure is checked for 10 minutes.

2.4 Machining: This stage involves the use of CNC machines for precise material removal. Crankshafts, essential components in compressors, undergo balancing to ensure smooth operation. The plant has a substantial production capacity, manufacturing 160 compressors. Connecting rod air gauge systems are also utilized in the machining process.

2.5 Assembly Section: This is where the individual components come together to form the final product. A key focus is on checking torque to prevent both leakage and breakage. The assembly process involves the precise assembly of parts and the verification of lever functioning, particularly at suction and discharge points. The lubrication cycle is critical, as it develops the necessary oil pressure for the compressor's operation. Safety valves are thoroughly checked to ensure they meet the required discharge pressure and level. To prevent rusting, nitrogen is filled through a vacuuming process, and pressure sensors are employed for monitoring. The assembly section also handles the assembly of two-stage compressors, including low-pressure (LP) and high-pressure (HP) stages. Piping is used to generate and direct oil pressure, which is crucial for loading processes. The

crankshaft plays a vital role in connecting to the oil pressurizing pipe, with pressure determining suction and discharge. Liners, springs, and gas pressure are all integral to the functioning of the discharge valve.

2.6 Spray Painting: This section focuses on the application of paint to the manufactured components. The process involves spray painting followed by heating in an oven, with temperatures reaching up to 80°C, including a soaking cycle. Air drying is then carried out, with temperatures gradually decreasing from 80°C to 35°C.

2.7 Gas Compressors (CNG): KPCL manufactures Gas Compressor (KGC) units specifically designed to handle CNG. The CNG compression process involves three stages: inlet conversion to 2 bar, 138 bar, and discharge above 200 bar. These compressors are positive displacement, double-acting compressors with an external lubrication system. Oil is used to lubricate connecting rods and cranks. Oil and lubricant are mixed with the gas and subsequently separated by an oil separator. The compressors are equipped with 2 suction and 2 discharge valves.

2.8 Screw Compressors: KPCL's manufacturing capabilities include 3-series screw compressors (3145, 3165). These compressors utilize male and female lobes, with gas compression occurring within these lobes. Discharge pressure is a critical performance parameter. Axial and radial clearance is meticulously maintained within a range of 80-100 µm. Hydraulic cylinders are used to control capacity, and profile coherence compression is employed. The plant also features an ammonia test bench that operates as a closed-loop system. This test bench utilizes a vapor-compression cycle, with ammonia compressed at -15°C.

2.9 Vapor-Absorption Unit: The plant includes a vapor absorption refrigeration unit that leverages waste heat. The unit's inlet temperature is 32°C, while the outlet temperature can reach as low as 1°C. Lithium bromide is used as absorbent and water is used as refrigerant. The vapor-absorption unit comprises of an evaporator, absorber, generator and condenser. Evaporator and absorber maintained under severe vacuum conditions.

2.10 Boiler: The boilers have a capacity of 3 TPH (boiler steam), and the plant operates with two boilers at 140°C. The tube side of the boiler involves combustion. The boiler inlet uses RO water, and insulation (Rockwool) is applied to prevent loss of heat.

2.11 Booster CNG Packages: Online CNG packages, equipped with engines, are used to ensure a continuous flow to the compressor. These packages utilize motors (10-15 bar) and LHP motors, with outlets operating at 250 bar. Air-cooled heat exchangers (ECG) are incorporated into these packages.

2.12 Non-CNG Packages: These packages are designed to handle both upstream and downstream boosting operations. They are capable of handling 400 to 1200 kg at pressures up to 250 bar, utilizing 22kW motors and pumps. SMH (600SHM) is used to compress 200 kg. Intensifier compressors, along with two pumps (400 SMH) and oil haulers, are employed. These packages find applications in petrol pumps and remote locations, with oil pressurized using compressors. Aerial compressors are used in non-CNG applications. Waukesha compressors are utilized, featuring 3-stage compression to reduce gas cooling and discharge temperature. Standard changes are implemented based on specific customer demands. Radiators are provided separately for cooling reciprocating compressors. Cooling systems include shell and tube heat exchangers designed for oil/gas and water (tube side) applications.

3. Learning Outcomes

The industrial visit to the KPCL plant yielded significant learning outcomes for the participants:

3.1 Manufacturing Processes: A detailed understanding of the end-to-end manufacturing processes involved in compressor production, from the initial receipt and inspection of components to the final assembly and rigorous testing of the products.

3.2 Compressor Types and Applications: In-depth knowledge of the various types of compressors manufactured by KPCL, including reciprocating, rotary screw, and centrifugal compressors, along with their specific industrial applications.

3.3 Quality Control and Assurance: Insights into the stringent quality control processes implemented at KPCL, such as pressure testing to detect leakages and the application of quality management tools like 5S, kaizen, and poka-yoke to maintain high standards throughout the production process.

3.4 Specialized Processes and Materials: Awareness of specialized processes like stress relieving, which is critical for ensuring the durability and reliability of components.

3.5 Company Strategies and Challenges: Exposure to KPCL's overarching operational strategies, including their commitment to continuous research and innovation, the adoption of energy-efficient technologies, and their approach to addressing industry challenges like energy efficiency, market competition, and regulatory compliance.

Photograph

4. Conclusion

The industrial visit to the KPCL plant provided a comprehensive and enriching educational experience. It offered a valuable opportunity to witness firsthand the complexities of compressor manufacturing, the importance of rigorous quality control, and the company's dedication to innovation and sustainable practices. The visit effectively bridged the gap between theoretical knowledge and real-world industrial applications, providing participants with a deeper appreciation for the engineering principles and manufacturing processes involved in the production.

Compiled by: Vaidehi Murdandgauda

Indian Institute of Tropical Meteorology

Industrial Visit

Report

Day and date - Tuesday, March 11, 2025

Name of Company – IITM (Indian Institute of Tropical Meteorology), Pune
Duration - 4 hours

Number of Participants -

- 20 students of Second Year & Third Year, Mechanical Department, (ASHRAE Members)
- Prof. Rujuta Agavekar, SBA
- Prof. Parag Chaware, SBA

Introduction

The Indian Institute of Tropical Meteorology (IITM), located in Pune, is a leading research institute under the Ministry of Earth Sciences (MoES), Government of India. Established in 1962, IITM is recognized for its pioneering work in meteorology, particularly monsoon research, climate modeling, air quality forecasting, and atmospheric sciences.

As part of its commitment to climate and sustainability research, IITM established the Research Centre for Climate Change (RCCC)—a model green building that demonstrates cutting-edge, energy-efficient climate control technologies. The facility integrates radiant cooling, earth tunnel ventilation, and a cascade cooling tower system, making it one of India's most sustainable and technologically advanced research centers.

Information:

Radiant Cooling Systems:

- Radiant cooling involves the use of cooled surfaces, typically ceilings or floors, to absorb and remove heat from a space primarily through radiation. Chilled water circulates through pipes embedded in these surfaces, lowering their temperature and subsequently cooling the surrounding environment. This method enhances thermal comfort and can be more energy-efficient compared to conventional air conditioning systems.
- The Research Centre for Climate Change (RCCC) employs a radiant cooling system where PEX (cross-linked polyethylene) piping is embedded within the building's concrete floors, ceilings, and roof. Chilled water circulates through these pipes, cooling the concrete mass and subsequently reducing the radiant surface temperatures.
- Key Features:
    - Quiet operation: Since it absorbs heat passively without moving air, this system is extremely quiet.
    - Night-time cooling: It runs during the cooler nights to save energy and store "coolth" in the building's materials.
    - Comfort: It keeps indoor temperatures around 24–25°C, which is pretty comfortable.
    - Up to 40–60% energy savings over traditional HVAC.
    - No fan-driven air circulation → reduced particulate movement

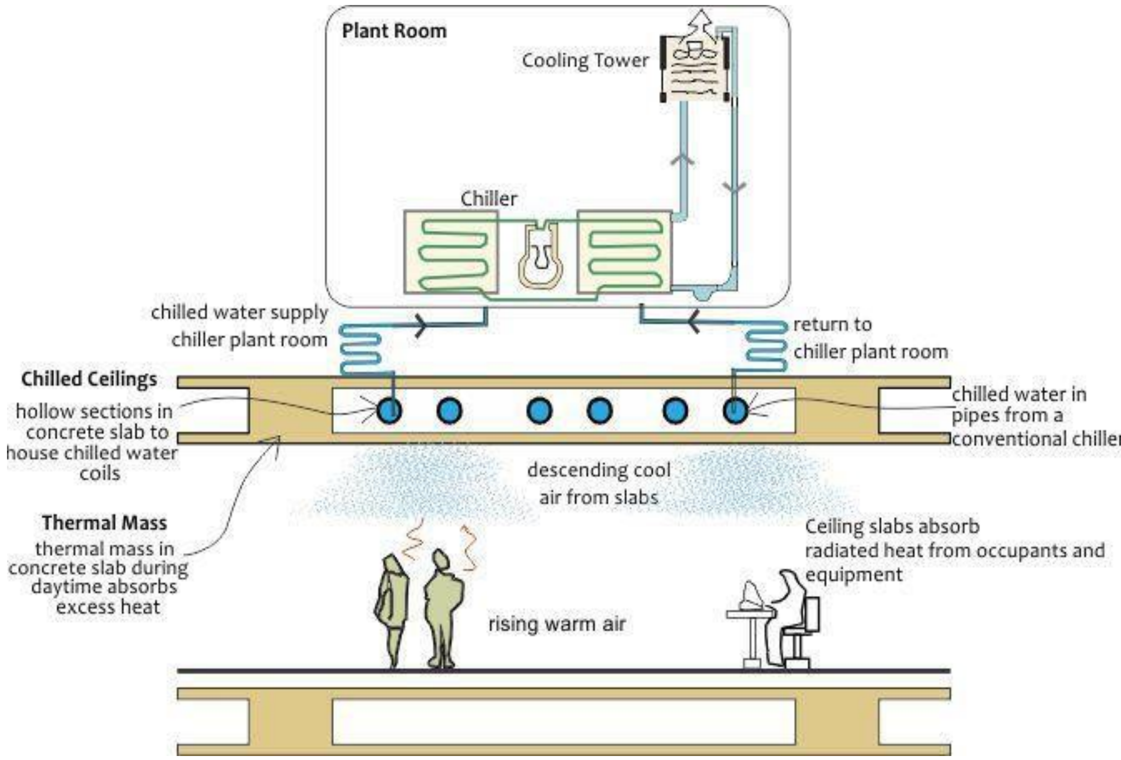

Fig: Schematic Diagram of Radiant Cooling System [1]

Earth Tunnel Ventilation System

- Earth tubes are underground ducts that leverage the earth's stable subterranean temperature to pre-condition ventilation air.
- Air passes through these buried tubes and exchanges heat with the surrounding soil, resulting in cooler air during summer and warmer air during winter before it enters the building. This passive system reduces the load on active heating and cooling systems, promoting energy efficiency.
- At IITM the system uses underground pipes buried ~4 meters below ground level, where the earth's temperature remains relatively constant (approx. 22–26°C in Pune). Ambient air is drawn through these pipes, and as it travels underground, it exchanges heat with the surrounding soil.
- System Components:
    1. Air intake with filters
    2. Underground ducts (~50–70 m long)
    3. Exhaust or distribution vents connected to indoor spaces

- **Advantages:**
    1. Pre-conditioning of ventilation air before it reaches indoor zones.
    2. Reduces reliance on mechanical cooling systems.

3. Supplies 100% fresh air, improving indoor air quality.
4. Enhances thermal comfort and oxygen levels

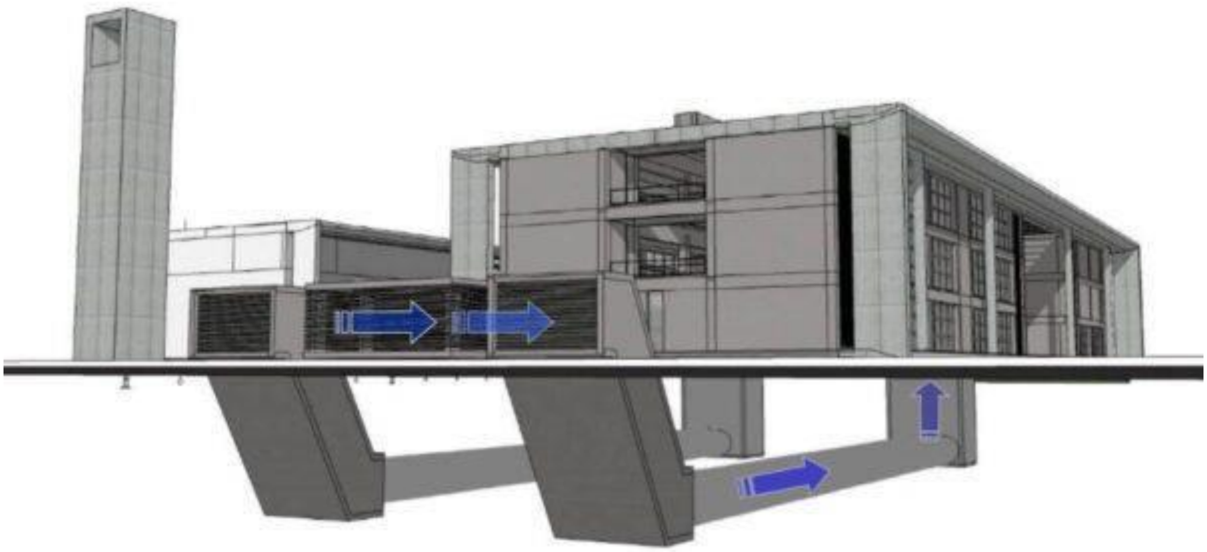

Fig: Earth tunnel system at IITM [2]

Cascade Effect Cooling Towers:

At IITM Cascade cooling towers employ a two-stage process that enhances the efficiency of evaporative cooling. The working of the system is as follows:

- Water is sprayed from the top and flows downward over fill material, increasing surface area for air-water contact. Air is pulled in from the sides and exits from the top, taking heat away via evaporation. Cools water to within ~2°C of ambient wet-bulb temperature.
- The cooled water is circulated to a heat exchanger that pre-cools incoming ambient air for the cooling tower.
- This lowers the effective wet-bulb temperature, improving cooling efficiency.
- Two cooling towers, each at 75% load capacity, ensure that the system remains operational and efficient even if one unit requires maintenance.

Fig: Cascade Cooling Tower System at IITM [2]

Energy Efficiency Achievements: The integrated system maintains indoor operative temperatures below 25°C, with slight variations during monsoon seasons. Remarkably, the building's cooling system operates at approximately 25% of the energy consumption required by conventional air-conditioning systems, achieving similar indoor conditions while utilizing 100% fresh air. The system's power usage is approximately 15 Watts per square meter, significantly lower than traditional methods.

This innovative approach at the RCCC exemplifies the potential of combining radiant cooling, earth tunnel ventilation, and cascade effect cooling towers to create sustainable, energy-efficient building environments.

Supercomputers at IITM Pune

1. PRATYUSH 4PF HPC System:
    - “Pratyush” is a Cray-XC40 LC [Liquid Cooled] System with 3315 nodes

running Intel Xeon Broadwell E5-2695 processors with a peak performance of 4,006 TFLOPS and a total system memory of 414TB.

- Applications like GFS, WRF, ROMS, CFS are available on the system for weather forecasting.
- It is one of the two fastest supercomputers in India with the other being MIHIR.

2. Aaditya 790+TF HPC System

- ADITYA is 790+ Tera Flops High Performance Computing System IBM iDataPlex cluster, which features 38,144 Intel Sandy Bridge processors and 149 TB of memory.

Supercomputer Cooling

Efficient cooling is crucial for maintaining the performance and longevity of supercomputers like Pratyush. Two primary cooling methods are employed in HPC environments:

1. Air Cooling:
   - Mechanism: Utilizes fans and heat sinks to dissipate heat from electronic components.
   - Advantages: Simpler infrastructure and lower initial costs.
   - Limitations: Less efficient for high-density systems and can lead to higher ambient temperatures.

2. Liquid Cooling (e.g., Glycol Solutions):
   - Mechanism: Circulates liquid coolants, such as water or glycol solutions, through cold plates attached to components or through immersion techniques.
   - Advantages: Higher thermal conductivity, efficient heat removal, and suitability for densely packed systems.

Learning Outcomes:

1. Combining passive cooling methods (like earth tunnels) with active cooling systems (such as cascade cooling towers) creates a hybrid solution that considerably cuts down on energy use while keeping things comfortable.
2. Temperature and humidity can be stabilized using non- mechanical air conditioning methods.
3. By using the radiant cooling system, the setup uses thermal mass to store coolth, allowing energy consumption to shift to non-peak hours.
4. Using fresh air from earth tunnels and reducing air recirculation which helps reduce indoor pollutants and improve indoor air quality.
5. The cooling infrastructure is key to understanding how supercomputers like

Pratyush can operate reliably without overheating.

Photographs

Conclusion

The Research Centre for Climate Change at IITM, Pune exemplifies a **visionary and actionable approach** to sustainable infrastructure. By integrating **radiant cooling**, **earth ventilation**, and **cascade cooling towers**, IITM has significantly lowered its carbon footprint while enhancing indoor comfort and air quality.

This energy-efficient system uses only **~25% of the power** consumed by conventional air conditioning while maintaining comparable comfort levels, making it **one of the most environmentally responsible buildings in India**. It also plays a critical role in supporting high-performance computing operations, ensuring that computationally intensive research can continue without overheating or energy waste.

Compiled by - Vaidehi M. Gauda

Visit to Yashwantrao Chavan Natyagruha Report

Day - Tuesday

Date -April 22, 2025

Location of Visit - Pune

Duration - 2 hours

Number of Participants -

- 60 students from Third Year, Mechanical Engineering Department
- Prof. Rujuta Agavekar, SBA

Central Air Conditioning Facility at Yashwantrao Chavan Natyagruha, Pune

This is a study report of the central air conditioning system installed at Yashwantrao Chavan Natyagruha, Pune. The place where many cultural events, plays are organized requires a very reliable and efficient air conditioning system to ensure a thermally comfortable indoor climate. To address these needs, a centralized chiller-based air conditioning system has been installed which effectively controls indoor air quality, temperature, and humidity

The main components of the Central Air conditioning system are as follows.

1. Vapor Compression Refrigeration System
2. Air Handling Units

3. Cooling Towers

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1. **Vapor Compression Refrigeration System**:

- **Screw Compressor**:

It is the core of the vapor compression refrigeration system. It is a positive displacement Machine which compresses low pressure and low temperature refrigerant vapor into high pressure and high temperature refrigerant vapor. It consists of two mating, interlocking helical rotors which compress the refrigerant vapor. Screw compressors are used in high-capacity systems (such as this 80 TR chiller) due to their continuous, smooth, and highly efficient operation. They also contain fewer moving parts than reciprocating compressors, resulting in improved reliability and reduced maintenance requirements.

- **Evaporator (Shell and Tube Type):**

In the evaporator, R134a removes heat from the water and chilled water is produced. Refrigerant flows through the tubes and water is on the shell side. Chilled water at 6ºC is supplied to the cooling coil of the Air Handling Unit from evaporator where it picks up heat from auditorium air and returns to evaporator at around 13ºC.

- **Condenser (Shell and Tube Type):**

In the condenser, refrigerant vapor undergoes condensation by rejecting heat to the water. The refrigerant vapor is on the shell side and water is circulated through the tubes. The warm water from the condenser is taken to the cooling towers where it is cooled by evaporative cooling and supplied back to the condenser.

- **Expansion Valve**:

The Thermostatic Expansion Valve (TXV) is a regulating device which accurately controls the flow of refrigerant into the evaporator. It detects refrigerant temperature and pressure at the outlet of the evaporator and adjusts the valve opening accordingly. By expanding refrigerant from high pressure to low pressure, it reduces the refrigerant's temperature considerably, thus enabling efficient absorption of heat within the evaporator.

2. **Air Handling Unit:**

The AHU consists of mainly air filters, chilled water coils and a centrifugal blower. The warm air from the auditorium is passes through air filters and then over the chilled water coils. As the air rejects the heat to the chilled water and gets cooled. The moisture content removed is collected in the tray kept underneath the chilled water coils. Centrifugal blower the cooled and dehumidified air to the auditorium via diffusers fitted in the ceiling.

3. **Cooling Towers**

The cooling tower is an essential part of the water-cooled condenser system. After absorbing heat from the refrigerant, the condenser water becomes warm. The cooling tower removes this heat by exposing the water to ambient air. Water is sprayed within the cooling tower and mixes with air, allowing a part of the water to evaporate, which cools down the rest of the water. This cooled water is re-circulated back to the condenser.

Photographs

Conclusion:

The central air conditioning facility at the play theatre consists of two vapor compression refrigeration systems each having 80 TR capacity, air handling units and cooling towers for water cooled condensers. The system has been designed to provide the required thermal comfort to the high occupancy cultural complex.

Compiled by: Snehal Madne

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