Design For HVAC System for Ramteke Hospital

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Abstract - This study outlines the comprehensive design and execution of a Heating, Ventilation, and Air Conditioning (HVAC) system tailored for Ramteke Hospital. It emphasizes the integration of efficiency, indoor comfort, and stringent hygiene control, achieved through Daikin's Variable Refrigerant Volume (VRV) systems and centralized chilled water solutions. Through meticulous heat load assessments conducted across multiple floors and specialized zones, the system ensures regulatory compliance with standards such as ASHRAE 170 and NABH. The outcome delivers not only optimized thermal performance but also future-ready scalability for healthcare facilities.

Key Words: HVAC design, VRV systems, hospital air conditioning, indoor air quality, chilled water system, healthcare engineering, energy optimization

1. INTRODUCTION

HVAC systems are essential in maintaining controlled indoor environments, especially in healthcare institutions where air purity, thermal comfort, and microbial safety are paramount. The goal of this project was to develop a robust HVAC design for Ramteke Hospital by leveraging advanced thermodynamic principles, modern energy-saving technologies, and hospital-specific zoning strategies.

2. LITERATURE REVIEW

A. Environmental Control in Hospitals
Medical facilities require precise environmental regulation. Guidelines from ASHRAE mandate specific humidity, temperature, and pressure conditions across different hospital departments.

B. Infection Prevention Measures
HVAC systems contribute to infection mitigation via HEPA filtration, air exchange protocols, and pressure zoning, particularly in ICUs and isolation wards.

C. Enhancing Energy Efficiency
Modern HVAC installations use intelligent controls such as VAV (Variable Air Volume), energy recovery devices, and smart zoning to reduce operational costs without compromising comfort.

D. Contextualizing for Indian Infrastructure Considering climate variability and power reliability in India, hybrid ventilation and solar-assisted systems have proven effective, especially for medium-scale healthcare institutions like Ramteke Hospital.

3. METHODOLOGY

The design approach was structured in stages:

- Data Collection

  Site-specific information such as room dimensions, orientation, occupancy, and internal equipment heat output were recorded.

- Load Assessment

  Sensible and latent heat loads were calculated in accordance with ASHRAE standards, accounting for structural and internal gains.

- System Zoning

  Hospital areas were segmented into sterile, clinical, and non-clinical zones, each with tailored HVAC requirements.

- Equipment Selection

  VRV systems were selected for outpatient and administrative zones, while critical care zones were assigned chilled water-based systems with dedicated Air Handling Units (AHUs).

Example Load Values:

- **First Floor: ~10.9 TR**
- **Third Floor: ~8.3 TR**
- **Fourth Floor:~9.4 TR**
- **Fifth Floor: ~11.9 TR**

4. PRINCIPLE

Air conditioning systems function by extracting excess heat from indoor spaces to regulate thermal conditions, humidity, and air cleanliness. This process is governed by the vapor-compression refrigeration cycle, where a working fluid (refrigerant) undergoes phase changes to transfer heat efficiently. The cycle includes four core components: a compressor that increases refrigerant pressure, a condenser where heat is dissipated to the surroundings, an expansion valve that lowers refrigerant pressure, and an evaporator that absorbs heat from the indoor air. Supporting mechanisms such as fans ensure even air distribution, and air filters help improve air quality. Control systems like thermostats and sensors enable automated climate management based on desired set points..

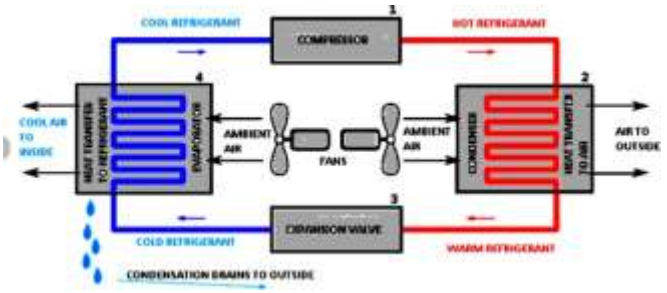
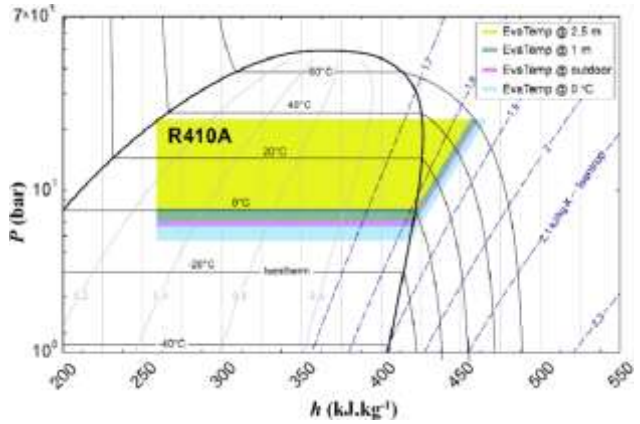


Fig -1: Principles of Air Conditioning

Charts



5. CONCLUSIONS

The HVAC system developed for Ramteke Hospital achieves a harmonious balance between functionality, energy conservation, and health-centric design. VRV systems enhance efficiency in flexible spaces, while chilled water systems meet the stringent climate requirements of surgical and diagnostic zones. With integration into a centralized BMS, the system ensures real-time oversight, adaptability, and long-term sustainability, making it an ideal solution for modern medical infrastructure.

6. ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to Assistant Professor A. S. Nilewar, for his invaluable guidance, technical insights, and constant support throughout the duration of this project. We are also thankful to Professor Satish P. Lokhande, Project Coordinator, and Mr. Shubham Gupta for their timely advice and assistance.
Special thanks to Dr. I. A. Khan, Head of the Department of Mechanical Engineering, and Dr. S. A. Dhale, Principal, Priyadarshini College of Engineering, Nagpur, for providing the necessary resources and an encouraging academic environment. We are grateful to the management and staff of Ramteke Hospital for their cooperation and for allowing access to critical design data that made this study possible. Lastly, we extend heartfelt thanks to our families and peers for their moral support and motivation during the project.

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