

HVAC Systems Track: Comprehensive Program Overview

Sapiens AI Team

From Fundamentals to Commercial Building Design

Program Goal & Core Topics

Program Goal

- Design and analyze HVAC systems.
- Culminating in a comprehensive **commercial building design**.

Mini Project

- Apply learned principles to design an HVAC system.
- Focus on a **small commercial building scenario**.

Core Topics

HVAC Basics

Psychrometrics

Load Calculations

System Components

Duct Design

Green HVAC
Practices



Phase 1: Foundational & Core Concepts

Months 1 & 2 - Online

Month 1 Goal: Foundational Concepts

Master HVAC basics, psychrometrics, and common air-side/water-side components.



HVAC Basics: Understand fundamental principles, thermal comfort, and air quality.

Psychrometrics:

Learn properties of moist air and use psychrometric charts.

Month 1



Air-Side Components: Identify functions of AHUs, fans, filters, and coils.



Water-Side Components: Explore chillers, cooling towers, boilers, and pumps.



Month 2 Goal: Core Design Concepts

Understand load calculations, system selection, duct design, and green HVAC practices.

Month 2

Load Calculations: Learn methods for calculating heating and cooling loads. 📐

System Selection: Evaluate different HVAC systems like VRF, hydronic, and all-air. 🔧

Duct Design: Master air distribution, duct sizing, and layout optimization. 📏

Green HVAC: Understand sustainable design and energy efficiency strategies. 🌱

Month 1: HVAC Fundamentals & Core Components

(Weeks 1-2)

Week 1: Introduction to HVAC & Basic Thermodynamics

HVAC Basics

Definition & Importance: HVAC systems are essential for maintaining indoor environmental quality, providing thermal comfort, and ensuring proper air circulation for well-being and building energy performance.

Applications:

Residential: Homes, apartments, condominiums.

Commercial: Offices, retail, hospitals, schools.

Industrial: Manufacturing, data centers.

Week 2: Psychrometrics and Air Properties

Moist Air Properties

Significance: Crucial for understanding indoor comfort, air conditioning processes, and dehumidification.

Dry-bulb (DBT): Standard air temperature.

Wet-bulb (WBT): Temperature at saturation via evaporation.

Dew-point (DPT): Temperature where condensation begins.

Humidity Ratios: Mass of water vapor per unit

Month 1: HVAC System Components

(Weeks 3-4)

Week 3: Air Side & Refrigeration Cycle Introduction

Air Handling Units (AHUs)

Units that condition and circulate air. Types include **Centralized**, **Packaged**, and **Modular**. Key sections are:

Filters: Ensure air quality by removing particulates.

Coils: Perform heat exchange (heating/cooling).

Fans: Circulate air throughout the system.

Dampers: Regulate the volume of airflow.



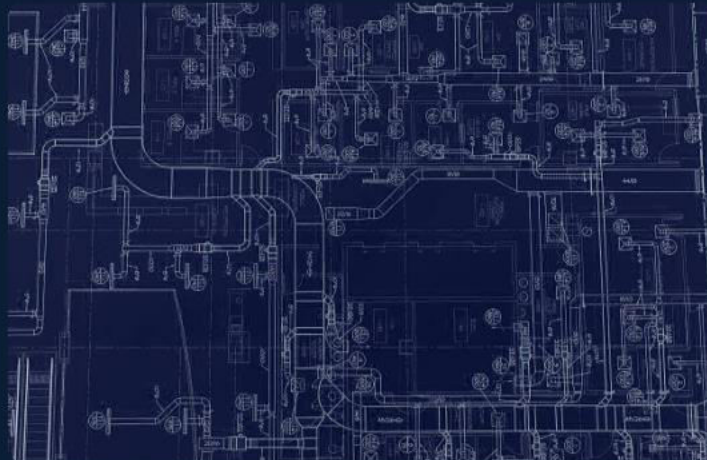
Fans & Ductwork

System for air movement. Includes **Centrifugal** & **Axial** fans. Ductwork consists of:

Supply/Return Ducts: Primary air pathways.

Grilles/Diffusers: Air distribution terminals.

Fan Laws: Govern fan speed, airflow, and power.



Vapor-Compression Cycle

The core thermodynamic process for cooling, involving four main components:

Evaporator: Absorbs heat from the space.

Compressor: Increases refrigerant pressure.

Condenser: Rejects heat to the outdoors.

Expansion Valve: Reduces refrigerant pressure.



Week 4: Water Side & Heat Rejection

Month 2: Load Calculations & System Design

Weeks 5-6

Week 5: Load Calculation Principles & Components



Purpose

Accurately sizing HVAC equipment for optimal comfort, energy efficiency, and preventing issues from incorrect sizing.



Heat Gain Sources

External: Solar radiation, conduction through walls/roof.

Internal: People, lights, equipment.

Air: Infiltration (leaks), Ventilation (controlled).



Heat Loss Sources

Primarily through conduction, infiltration, and ventilation during colder periods.



Informs System Design

Week 6: System Design & Equipment Selection



HVAC System Classifications



All-Air



All-Water



Unitary



Heat Pumps



Key Selection Factors

Building Type

Climate

Budget

Energy Efficiency

Maintenance



Basic Sizing Principles

Matching calculated heating and cooling loads directly to equipment capacities from manufacturer data to meet building demands effectively.

Month 2: Duct Design & Green HVAC Practices

(Weeks 7-8)

Week 7: Duct Design & Air Distribution

This week focuses on the fundamental principles of duct system design, ensuring efficient air delivery and optimal thermal comfort.



Duct Materials & Sizing

Galvanized Steel, **Fiberglass**, and **Flexible Ducts** are common materials. Sizing methods like **Equal Friction** (balanced, simpler) and **Static Regain** (energy-efficient) are critical for performance.



Layout & Components

A system comprises **main and branch ducts**. **Turning vanes** reduce pressure loss at bends, while **dampers** are crucial for balancing and controlling airflow volume to different zones.



Air Distribution Devices

Diffusers mix and distribute air to prevent drafts. **Grilles** handle return/exhaust air, and **Registers** offer adjustable louvers for directional control.



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Week 8: Energy Efficiency & Green HVAC Practices

This week covers critical strategies for sustainable HVAC operation and introduces the final design project.

Phase 2: Industry Immersion & Integrated Project

(Month 3 - Offline)

Month 3 Goal

Design a complete HVAC system for a small commercial building using industry-standard software.



Week 9: Project Kick-off & Software Application

INITIATION Receive project briefs, plans, and operational requirements for a commercial building.

IMMERSION Hands-on training in professional software like Carrier HAP or Trane TRACE.

APPLICATION Perform advanced load calculations considering all building and climate factors.

Week 10: System & Equipment Selection



DESIGN Select optimal HVAC systems (e.g., VRF, Chilled Water) based on calculated loads.

SIZING Use software and manufacturer data to size chillers, boilers, and AHUs accurately.

OPTIMIZATION Balance initial cost, efficiency, and maintenance during selection.



Month 3: Capstone Mini Project - Commercial HVAC Design

(Weeks 9-10)



Project Focus: Integrated Commercial HVAC Design

The Capstone Mini Project is a hands-on application where participants design a comprehensive HVAC system for a commercial building, integrating all learned principles and utilizing professional-grade software. This two-week intensive period lays the critical groundwork for the full design.

↗ Week 9: Project Kick-off & Advanced Load Calculation Software Application

- **Software Training:** Intensive practical training on professional HVAC design software is central to this week. Participants will gain proficiency in industry-leading tools such as Carrier HAP and Trane Trace, essential for accurate and efficient design.
- **Building Modeling:** Learners will apply software capabilities to model building geometry, input detailed construction data, define internal heat loads (occupants, lighting, equipment), and establish zoning strategies crucial for precise load calculations.



Week 10: HVAC System & Primary Equipment Selection



Month 3: Design, Optimization & Showcase

(Weeks 11-12)

Week 11: Integrated Design & Optimization



Ductwork Design & Airflow Optimization

Designing efficient air distribution systems, including

primary/secondary runs , plenums , and diffusers for proper airflow and minimal pressure drop.



Hydronic Piping System Layouts

Developing layouts for chilled water , hot water , and condenser water systems for efficient fluid circulation.



Week 12: Project Showcase & Career Launchpad

Career Development & Program Conclusion

Career Development Workshops

Resume & Portfolio Building

Craft compelling resumes and portfolios that effectively highlight technical skills and project experience from the program.

LinkedIn Optimization

Optimize your LinkedIn profile with relevant keywords and project showcases to attract opportunities in the HVAC industry.

Mock Interviews

Prepare for real-world scenarios

Industry Networking Session

Connect directly with leading professionals from various sectors of the HVAC industry to gain insights, explore career paths, and find potential mentorships.



Meet Key Industry Players:

Graduation & Certification

Formal Program Conclusion

A ceremony to celebrate your successful completion of the intensive HVAC Systems Track, recognizing your dedication and hard work.

Official Certification

Receive an official certification validating your mastery of HVAC system design, operations, and green practices, confirming your readiness for professional roles.