

## ES 72- Heating Ventilating and Air Conditioning Systems

De Anza College- Spring 2003  
Steve Murphy

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## ES 72: Logistics

- **Class website:**  
<http://bhs.deanza.edu/faculty/sMurphy>
- **Website postings:**
  - course syllabus
  - assignments
  - PowerPoint files/class notes
  - Field trip directions/notes
- **List serv signup:**
  - [www.distance.deanza.fhda.edu](http://www.distance.deanza.fhda.edu)
  - access to class dialogue and other EMT "happenings"
- **My e-mail address:**  
[mrph@gte.net](mailto:mrph@gte.net)

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## Careers in "HVAC"

- **HVAC:**  
Heating, Ventilating and Air Conditioning
- **Branch of Mechanical Engineering**  
(Thermal/ Fluids option)
- Int'l professional organization  
"ASHRAE"
- **ASHRAE**  
**American Society of Heating, Refrigerating and Air conditioning Engineers**
- **Student memberships!**

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## Careers in “HVAC”

- **“Waves of Opportunity”** in HVAC:
    - Bay Area/Silicon Valley HVAC needs
      - **Clean rooms for semiconductor manufacturing**
      - **Biotech/Pharmaceutical industry growth**
- HVAC systems are part of manufacturing processes !!**
- Indoor Air Quality (IAQ) concerns
    - System retrofits for better ventilation!
  - Global warming and effect on CFC's and refrigerants
  - Energy Crisis !!
    - Retrofits of existing systems for better energy use

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## Careers in “HVAC”

- Consulting engineering
- Design/build construction
  - project managers
  - estimators
  - sales
  - AutoCad designers
  - service managers
- Technical Sales
- Facilities Engineering
- Direct Digital Controls
- Energy Management
- Teaching and Research
- Utilities/Power plants
- Service Technicians

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## HVAC Module- Overview

- Primary purpose of HVAC for commercial/educational facilities-
  - Human thermal comfort
  - Indoor Air Quality
- Terms/Definitions/Key Concepts
- HVAC System Types
  - Energy usage implications
  - Package systems vs. “custom/built-up” systems
- Energy Conservation Opportunities

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## Human Thermal Comfort

### ■ **Critical parameters:**

- Temperature- "hot vs. cold"
- Relative humidity- "muggy vs. dry"
- Air distribution- "drafty vs. stale"

### ■ **ASHRAE Standards**

- Good design = what % satisfied with individual environment ??

### ■ **Other concerns:**

- Clothing level
- Metabolic rate

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## Indoor Air Quality (IAQ)

### ■ **UBC/UMC/Title 24 Ventilation rates:**

- "old" building code (prior to 1991)
  - 5 CFM OSA per person/15 CFM recirculated per person
  - goal was to save energy during oil crisis (late 70's/early 80's)
- "current" building code
  - 15 CFM per person or 0.15 CFM/sq. ft.
- ASHRAE recommendation
  - 20 CFM per person for classroom/office space

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## Indoor Air Quality (IAQ)

### ■ **"Sick Building Syndrome":**

- Inadequate ventilation due to old code compliance
- Poor maintenance of HVAC equipment
  - standing water @ condensate pans
  - Bacteria growth @ cooling towers (Legionella)
- Outgassing of building materials
  - paint, furniture, carpeting, etc
  - "bake-out" prior to occupancy ??

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## Definition of Terms/Concepts

- **Heat flow/Heat transfer/“ENERGY”:**
  - Temperature- “intensity” of heat
    - dry bulb temp vs. wet bulb temp vs. dew point temp
  - Btu- British Thermal Unit
    - “Quantity” of heat- WATER BOTTLE DEFINITION!!
  - Btu/hour- **RATE** of energy exchange
  - Watts 1 watt = 3.414 Btu/hour
  - Tons 1 ton = 12,000 Btu/hour
  - HP 1 HP = 2,545 Btu/hour  
1 HP = 745 watts

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## Definition of Terms/Concepts

- **Fluid Mechanics- (air/water flow)**
  - **Volume** of airflow: (**CFM**, cubic feet/minute)
  - **Speed** of airflow: (**FPM**, feet per minute)
  - **Pressure** of airflow: (“**w.g.**”, inches of water)
  - **Volume** of waterflow: (**GPM**, gallons/minute)
  - **Speed** of waterflow: (**FPS**, feet per second)
  - **Pressure** of waterflow: (**ft. hd.**; feet of head, feet of water)

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## Definition of Terms/Concepts

- **Basic air/water flow calculations:**
  - Btu/hour = (1.08)(CFM)(AIR temp difference)**
  - CFM = (FPM) X (area- ft<sup>2</sup>)
  - For package units/comfort cooling  
**1 ton cooling capacity = 400 CFM of airflow capacity**
  
- Btu/hour = (500)(GPM)(WATER temp difference)**
  - 3 GPM/ton if water temp difference is 8 F
  - 2.4 GPM/ton if water temp difference is 10 F
  - 2.0 GPM/ton if water temp difference is 12 F
  - 1.6 GPM/ton if water temp difference is 15 F

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## Definition of Terms/Concepts

### ■ **Energy/Operating Costs:**

- **BHP**--> "brake" HP; fan/pump energy
- **kw/ton**--> input power/cooling capacity
- **therms**--> 1 therm = 100,000 Btu

### ■ **Energy Efficiency Measures:**

- **EER/SEER**- efficiency rating for cooling equip
  - capacity in btu/hour/power used in watts
- **AFUE**- efficiency rating for gas furnaces/boilers
- **COP**- efficiency of heat pumps (heating mode)

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## Definition of Terms/Concepts

### ■ **Title 24 Standards:**

- dictated by California Energy Commission
- Building Envelope constraints:
  - insulation types and performance
  - glazing types and performance
  - infiltration
- Lighting system constraints:
  - lighting levels
  - fixture performance
  - use of "day-lighting" and occupancy sensors

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## Definition of Terms/Concepts

### ■ **Title 24 Standards (cont.):**

- HVAC System constraints:
  - need to justify sizing of proposed new equipment
  - efficiency rating of heating/cooling equipment
  - need for duct/pipe insulation
  - ventilation rates for building occupants
  - automatic temperature controls
  - automatic shutdown of equipment when not in use
  - discourages use of electric resistance heat
  - duct leakage rates for residential systems; duct taping and sealing methods

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