SALT LAKE COMMUNITY COLLEGE
PROFESSIONAL CEU COURSE

Course Outline: Home Air and Water Heating

HVAC Load Calculations

- Block load versus room-by-room
- Indoor and outdoor conditions
- Envelope load
- Infiltration/ventilation load
- Internal loads
- Duct loads and efficiency

HVAC Load Calculations

- Design conditions
    - In Manual J or similar source (*Residential Energy)*
    - Outdoor conditions
        - Heating 99% dry bulb temperature
        - Cooling 1% dry bulb temperature and coincident wet bulb temperature
    - Indoor conditions
        - Heating 70°F
        - Cooling 75°F, 50% RH
    - Infiltration rate = “tight” for new construction

HVAC Load Calculations

- Energy Star requires:
    - Use Manual J for cooling load
    - Use Manual S for equipment selection
    - Air Conditioners – maximum 15% oversize
    - Heat Pumps – maximum 25% oversize
    - Indoor and outdoor coils matched per ARI standards

HVAC Duct Calculations

- Sizes ductwork to deliver sufficient airflow
- Calculations include:
    - Pressure drop of duct (iwc/100ft)
    - Pressure drop of elbows and fittings
    - Pressure drop of filter, cooling coil
    - ‘Longest run’ critical pressure requirement
    - Fan ‘external static pressure’

HVAC duct calculations

- Flow to each room per load requirements from Manual J load calculations
- Poor design problems:
    - Insufficient airflow to rooms
    - Insufficient airflow at air handler
        - Coil freezing and low SHR
        - Overheating of furnace heat exchanger
        - Poor system performance, durability, and efficiency

Heating systems

- Forced air (furnace or fan coil)
- Radiant heat (boiler or electric)
- Electric baseboard

Forced air heating

- Most common heating system
- Fan powered
    - Furnace (natural gas, propane, oil)
    - Hot water coil (sometime used with radiant)
    - Electric heating coil (base heat or auxiliary)
    - Ductwork system
    - Sometimes ductless (mini-split HP)

Gas furnace

- Low efficiency (60% - 70% AFUE)
    - Natural draft, standing pilot, draft diverter and dilution air, 25 years old
- Mid efficiency (80% AFUE)
    - Fan powered draft, electronic pilot, current minimum performance
- High efficiency (90%+ AFUE)
    - High pressure draft fan, closed combustion capable, condensing heat exchanger, electronic pilot, Energy Star label, cat IV venting (plastic pipe)

Radiant heating

- Electric radiant, wires or mats
- Radiant hydronic heating
- Floor, wall, ceiling
- Radiators
- Baseboard

Radiant hydronic heating

- In-slab tubing systems
- Grooved subfloor systems
- Below subfloor systems

Radiant hydronic systems

- Low loop design temperatures for radiant floor (normally 85° F max surface, 90° F floor loop common, maybe higher if 'staple-up')
- May have primary-secondary loops and high/low temperatures
- Generally separate loop from any domestic hot water system

Programmable thermostat

Zoning systems

Zoning systems

Exercise

- Smith residence: Existing furnace about 30 years old. Gas bills in summer $40/month, in winter $120/month.
- Propose upgrade to 94% AFUE furnace, $3,500 installed cost.
- What is estimated energy savings and simple payback for retrofit of furnace?

Hot water energy usage

- 3500 kWh or 15% of electricity in home
- 230 therms or 25% of natural gas in home
- About 20 gal per day per person (15 to 40 gal)

Water heating energy

- Demand – energy to heat cold water up to setpoint as water is used
    - Water heater efficiency
    - Occupant behavior
    - Fixture consumption (flow rate, cycle use, etc.)

Water heating energy

- Standby energy
    - Loss through storage tank's walls
    - Loss through storage tank flue
    - Higher demand -> lower standby loss
    - Lower demand -> higher standby loss

Water heating energy

- Distribution losses
- Loss through pipes
- Loss through fixtures
- Thermo-siphon losses

Water heater capacity

- Input (kBtu/hr)
- Recovery capacity
    - Recovery efficiency (%)
    - 1st hour rating (gallon per hour)
    - Based on 3 to 20 gal per hour per person and delta T
- Storage capacity
    - Gallons
    - 8 to 20 gal per person
    - 30 to 65 gal per living unit

Water heater efficiency

- Energy Factor (EF)
    - Based on daily use of 64 gallons
    - Includes standby losses
    - Includes standing pilot (if present)
    - Value 0 to 1 (ratio of output to input)

Energy factor

- Electric
    - 0.90 minimum
    - 0.95 best
- Gas (storage)
    - 0.59 minimum
    - 0.62 Energy Star
    - 0.65 best
- Gas (tankless)
    - 0.82 Energy Star
    - 0.98 best

Water system types

- Storage (gas, electric, propane)
- Tankless (instantaneous)
- Side-arm
- Solar integrated

Learning Objectives:

Students will be able to identify various methods of heating air and water.

Students will be able to identify energy efficient methods for heating air and water.