HVAC Systems and Vapor Intrusion

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Air Handling System Components

- Fan
- Coils
- Dampers
- Sensors
- Supply
- Return
- Outside Air
- Exhaust

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Air Handling System Components

- Coils
- Fan
- Dampers
- Sensors

Hot Water/Steam
Chilled Water/DX

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Air Handling System Components

Return

Outside Air

Supply

Exhaust

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Air Handling System Components

- **Fan**
  - Moves air, provides +/- pressure

- **Coils**
  - Heat or cool (temper) air

- **Dampers**
  - Adjust air flow within ducts

- **Sensors**
  - Measure conditions in air handling system
  - Temperature, humidity, pressure, CO2, etc.
Air Handling System Components

- **Supply**
  - Air delivered to the occupied space
    - Positive pressure

- **Return**
  - Air from the space directed back to the AHU
    - Negative pressure

- **Outside Air**
  - Ventilation air mixed with return at AHU

- **Exhaust**
  - Air removed from the occupied space

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Pressure Fundamentals

- Positive Pressure
  - More Air In Than Out

- Negative Pressure
  - More Air Out Than In

- Neutral Pressure
  - Equal Airflows
Pressure Fundamentals

Stack Effect

- Air tends to enter a building at lower levels and exit at upper levels due to convection.

- This condition is increased by the presence of connections between lower and upper floors of the building (e.g., shafts).

- Stack effect is also greater when there are openings at the lower and upper levels.

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Pressure Fundamentals

- Pressure Conducting Pathways
  - Elevator Shafts
  - Stairways
  - Mechanical Chases
    - Pipe Chases
    - Conduits

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Pressure Fundamentals
Pressure Fundamentals

HVAC Systems

Unbalanced supply and return flows

Non-functional equipment

Return air plenums

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Vapor Intrusion Control

- Negative pressure below slab
  - Sub-slab suction
- Positive pressure above slab
  - Increased ventilation
- Negative pressure between source and occupants
  - Containment

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Vapor Intrusion Control

- Negative pressure below slab
  - Sub-slab suction
  - Assume 200 cfm exhaust
  - First cost?

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Vapor Intrusion Control

- Positive pressure above slab
  - Increased ventilation
  - Assume 2,000 cfm additional outside air
  - Change damper position to accomplish change

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Vapor Intrusion Control Economics

In New England Conditioning Outdoor Air Is Costly ($6-$12/Yr.CFM)
Vapor Intrusion Control Economics

- Sub-slab suction
  - 200 cfm x $9/cfm-yr = $1,800/yr
  - 10 year cost of operation = $18,000
  - First Cost??

- Increased ventilation
  - 2,000 cfm x $9/cfm-yr = $18,000/yr
  - 10 year cost of operation = $180,000
  - First cost = ~$0
Vapor Intrusion Control

- Negative pressure between source and occupants
  - Containment

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Vapor Intrusion Control

- Negative pressure between source and occupants
  - Walk-out Basement Example
Exhaust Reentrainment

Contaminants exhausted out of the building can be drawn in through intakes and other openings.

Fig. 3  Flow Recirculation Regions and Exhaust-to-Intake Stretched-String Distances (Wilson 1982)
Exhaust Reentrainment

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Questions & Comments.....

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