

Advanced Building Science

- Air Conditioning (Cooling)
 - Equipment
 - Systems
 - Efficiencies
 - Operations/Maintenance
- Readings
 - HF 20 (review only)
 - Air-Conditioning Handout

All-Air HVAC Schematic

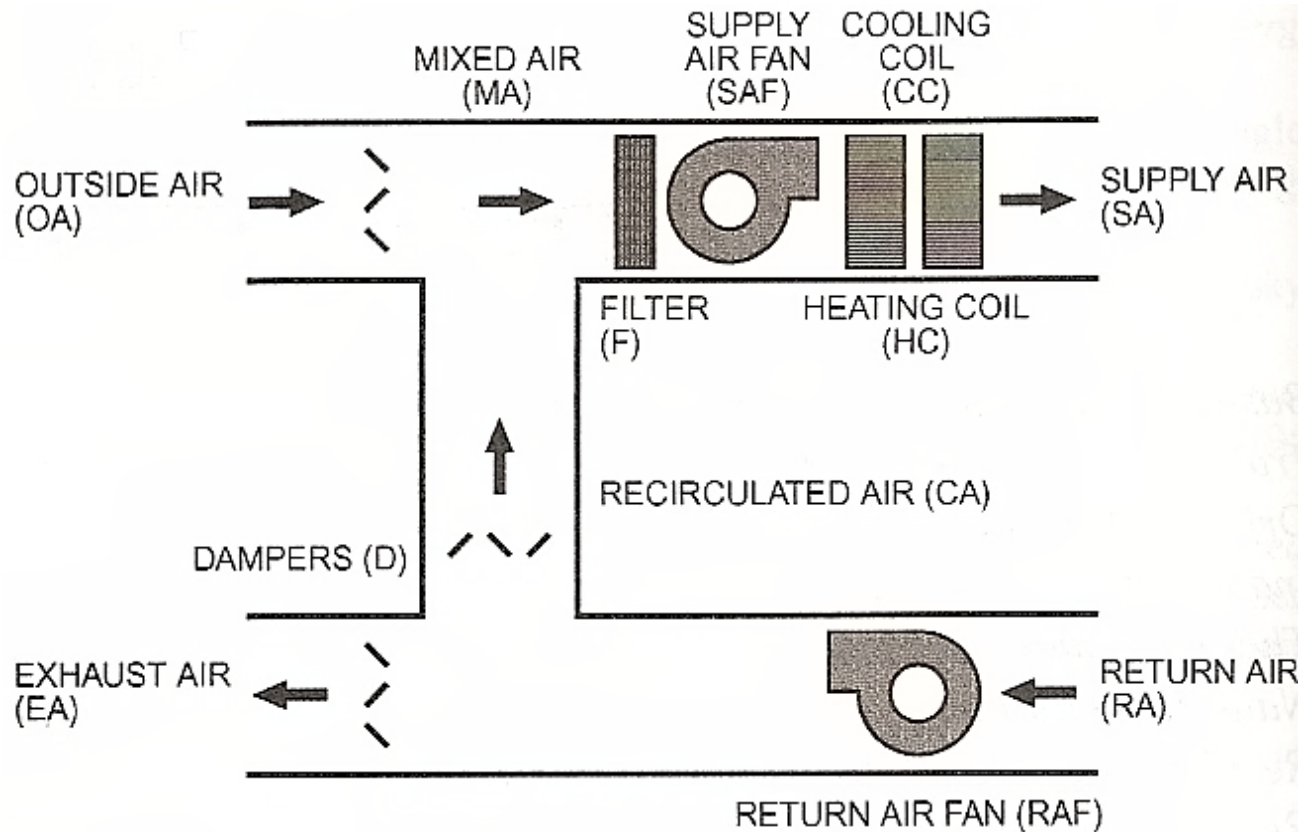


Fig. 2 Simple All-Air Air-Handling Unit with Associated Airflows

Source: ASHRAE Handbook Fundamentals 2013, Chapter 16.2

Cooling Systems

Unitary and Room Air Conditioners

- Characteristics of unitary equipment
- Window air conditioners
- Through-the-wall air conditioners
- Equipment efficiencies

Cooling Equipment

- Characteristics of Unitary Air Conditioners
 - Arrangement: single or split
 - Heat rejection: air, water, evaporative condenser
 - Unit exterior: decorative, functional, weatherproof
 - Placement: floor, wall, ceiling or rooftop
 - Indoor air: flow direction for stand-alone or use w/ furnace
 - Location: indoors, concealed, outdoors
 - Heating: combination using electric, gas, hot water, steam
- Single Package vs. Split Systems

Packaged Roof Top Unit (RTU)

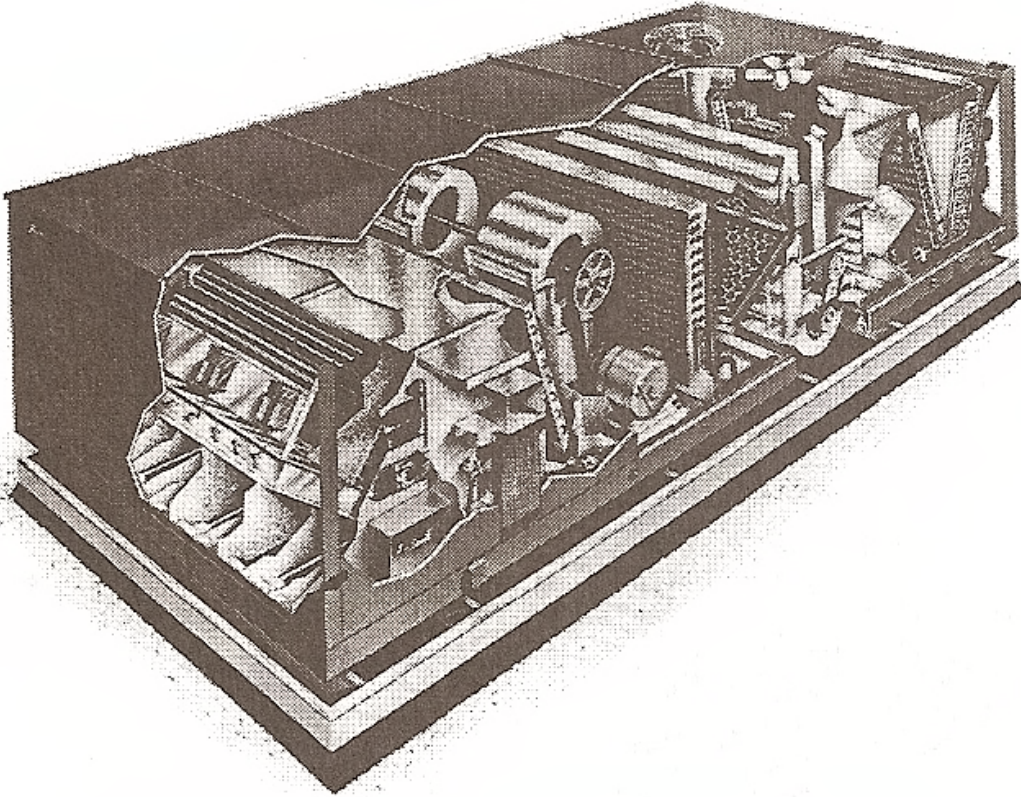


Fig. 14-1 Typical Rooftop Air-Cooled Single Package Air Conditioner

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.1

Packaged Roof Top Unit (RTU)

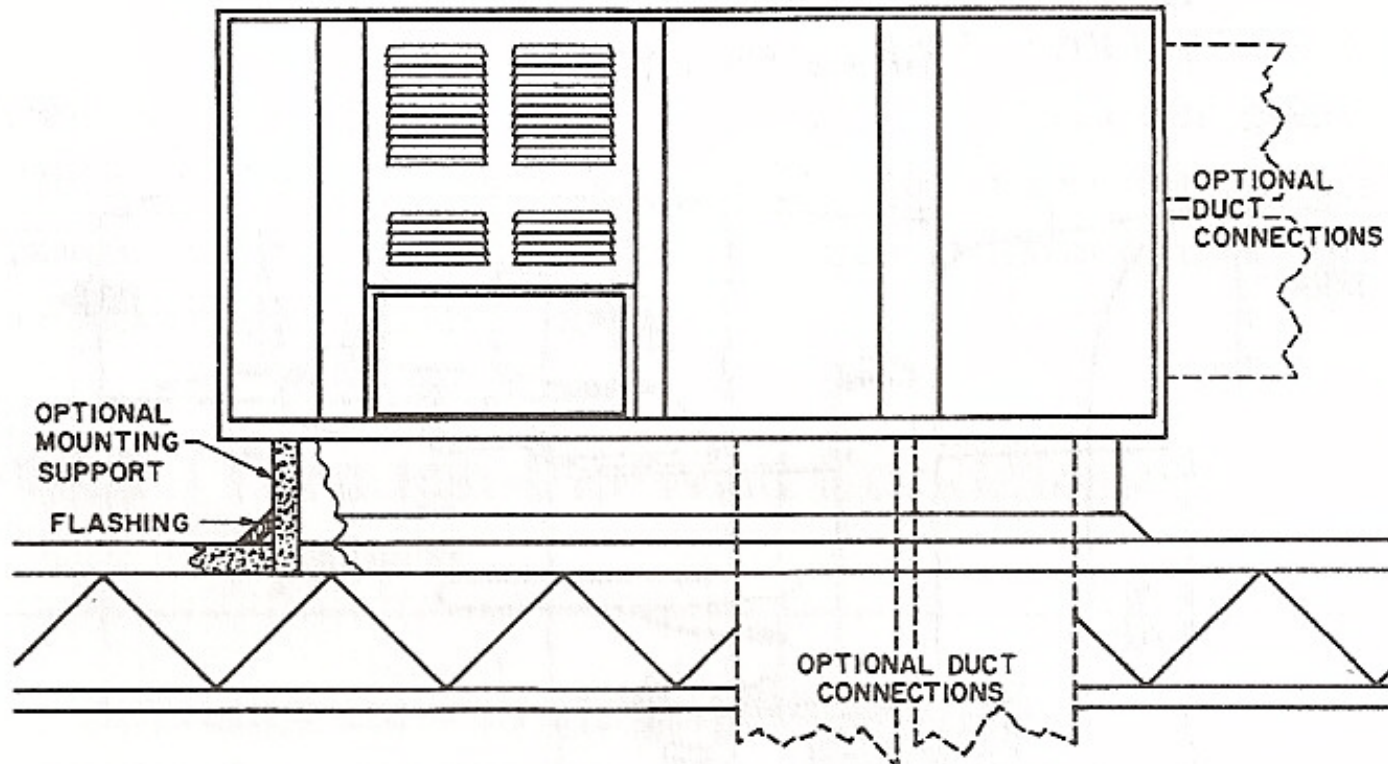


Fig. 14-2 Rooftop Installation of a Single-Package Unit

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.1

Package Unit (Through the Wall)

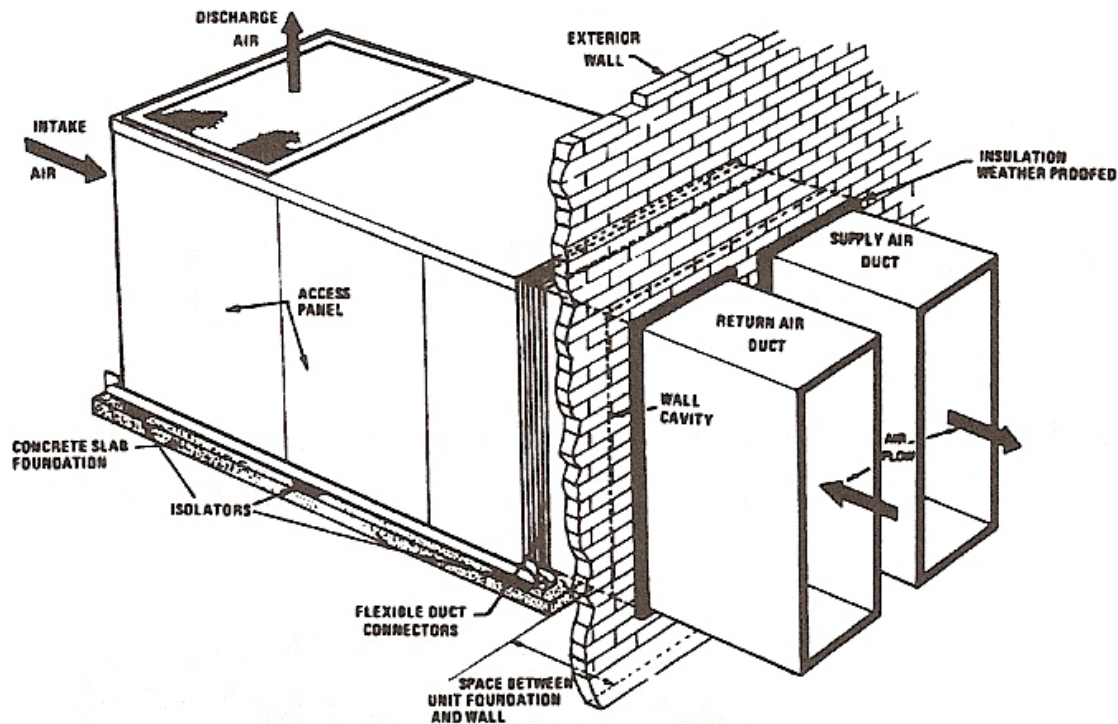


Fig. 14-3 Typical Through-the-Wall Air-Cooled Single-Package Unit

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.2

Package Unit (Through the Wall)

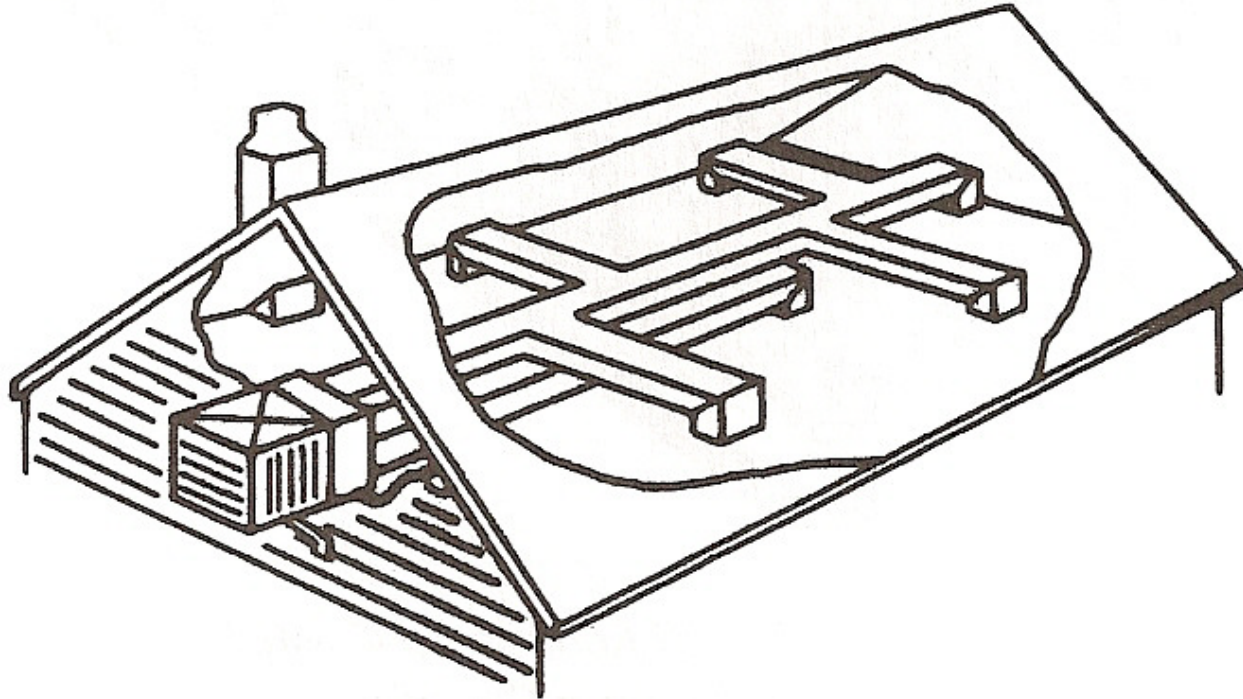
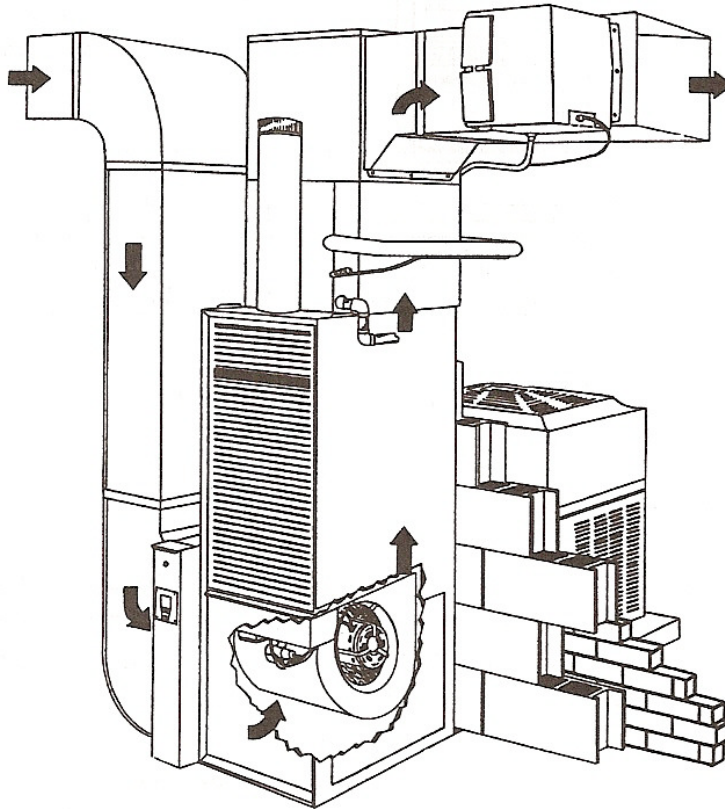


Fig. 14-4 Through-the-Wall Installation of a Single-Package Unit

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.2

Typical Residential Split System



*Fig. 14-5 Residential Installation of Split-System
Air-Cooled Condensing Unit with Indoor Coil
and Upflow Furnace*

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.2

Split System Installations

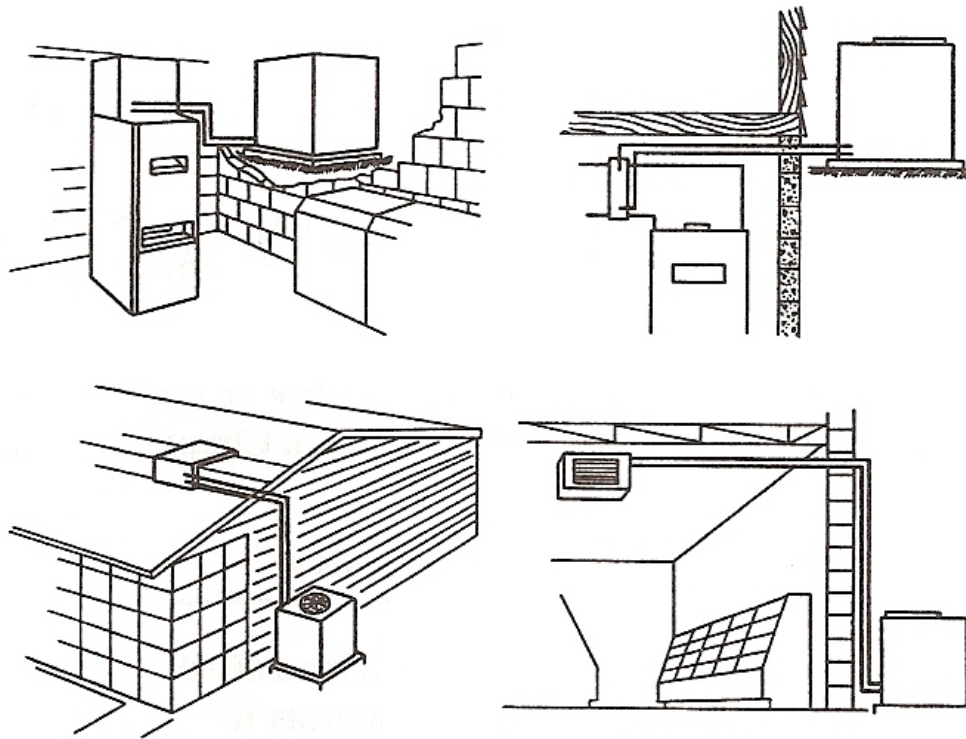


Fig. 14-6 Outdoor Installations of Split-System Air-Cooled Condensing Units with Coil and Upflow Furnace or with Indoor Blower Coils

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.2

Split System Installations

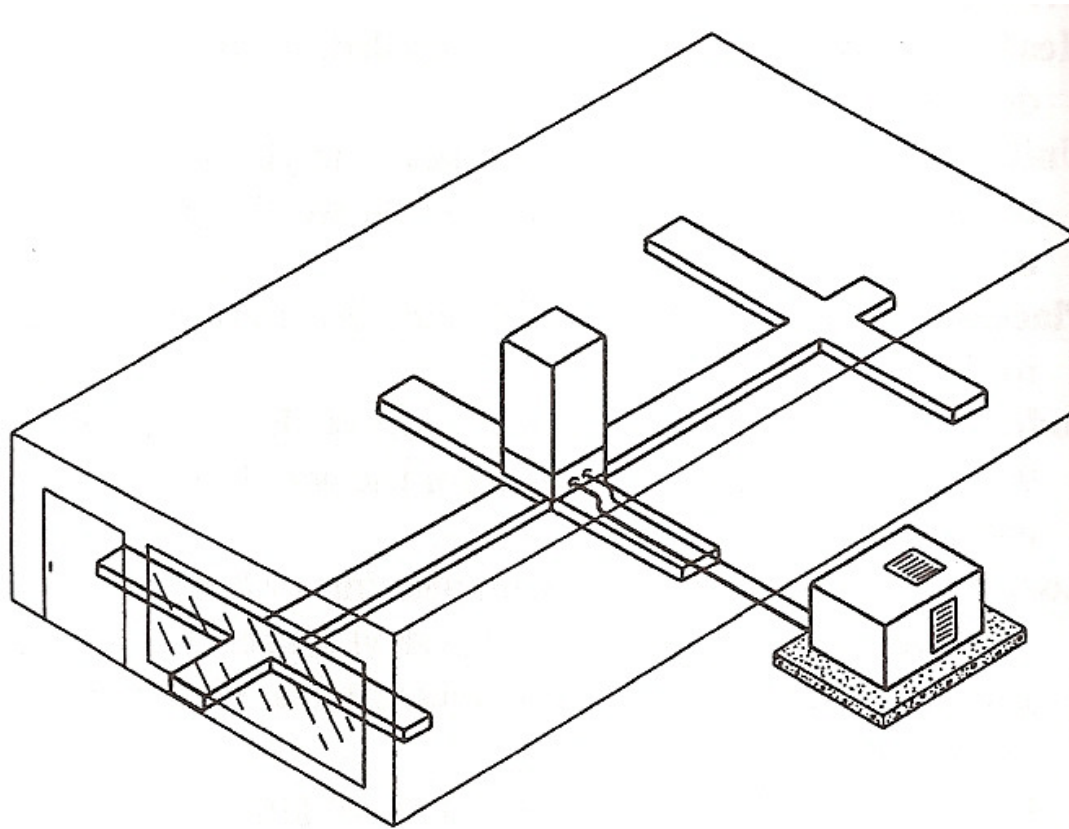


Fig. 14-7 Outdoor Installation of Split-System Air-Cooled Condensing Unit with Indoor Coil and Downflow Furnace

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.2

Cooling Equipment

- Multiple Unit Advantages

- Simple individual room controls
- Individual room air distribution
- Simultaneous heating & cooling
- Consistent, packaged performance
- Published certified ratings/data
- Manufacturer accountability
- Simplified, repetitive installation
- Redundancy (if one malfunctions)
- Usually saves space
- Usually lower initial costs
- Individual room can be shutdown

- Central Unit Advantages

- Sizing options
- Humidity control
- Energy efficiency
- ease of outdoor economizers
- Central distribution control
- Sound levels
- Increased ventilation options
- Less obtrusive (visually)
- Air filtration options
- Centralized maintenance

Window Air Conditioners

- Packaged unit for mounting in a window
- Intended to cool, dehumidify, filter, and circulate room air
- May provide ventilation air
- Capacities range from 4,000 to 36,000 Btu/hr
- Key selection criteria
 - initial costs
 - operating costs
 - sound levels
 - physical size
 - amperage
 - weight

Window Air Conditioners

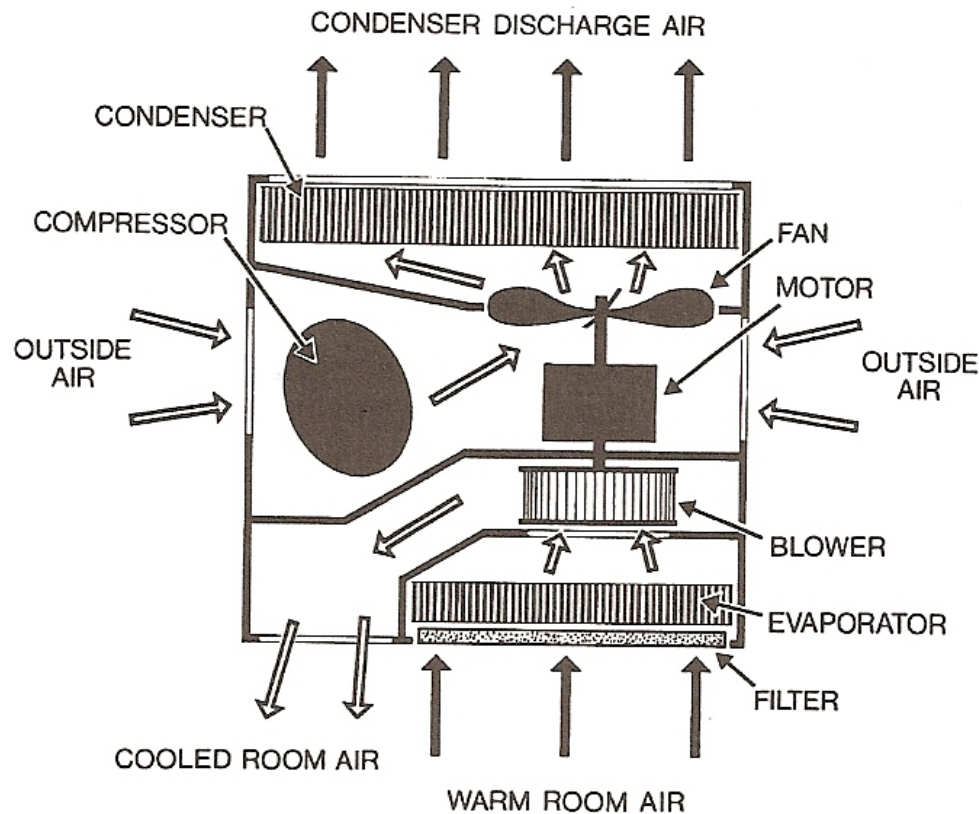


Fig. 14-8 Schematic View of Window Air Conditioner

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.3

Through-the-Wall Conditioners

- Air-cooled room air conditioner permanently mounted in the wall, normally capable of both heating and cooling
- Commonly called a “PTAC” (packaged terminal air conditioner)
 - requires no ductwork and may require less floor space
 - less costly for individual (simultaneous) heating and cooling
 - may be more efficient than central, but generally they are not as efficient
 - generally is not suitable to large spaces, unless it is carefully coordinated with a well-designed core system
 - most do not include humidification capability
 - very common in motels, apartments, schools, small offices

Through-the-Wall Conditioners

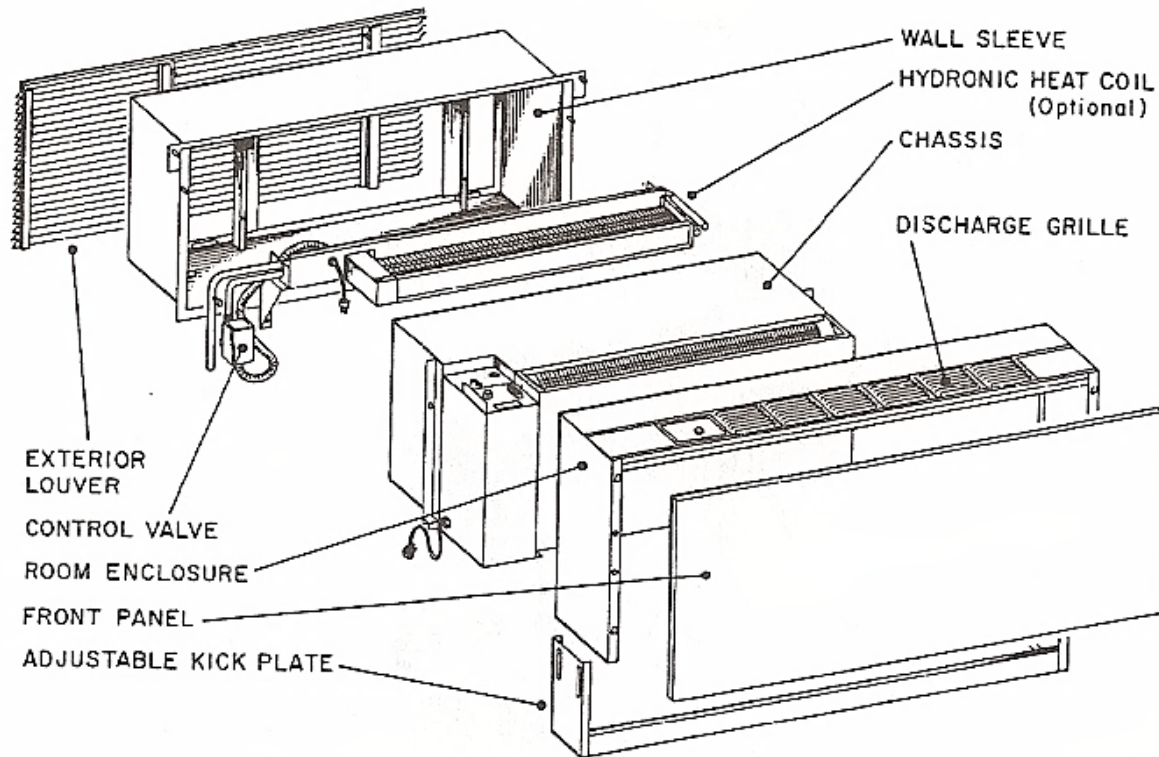


Fig. 14-9 Packaged Terminal Air Conditioner with Separate Heat Section and Cooling Chassis

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.4

Through-the-Wall Conditioners

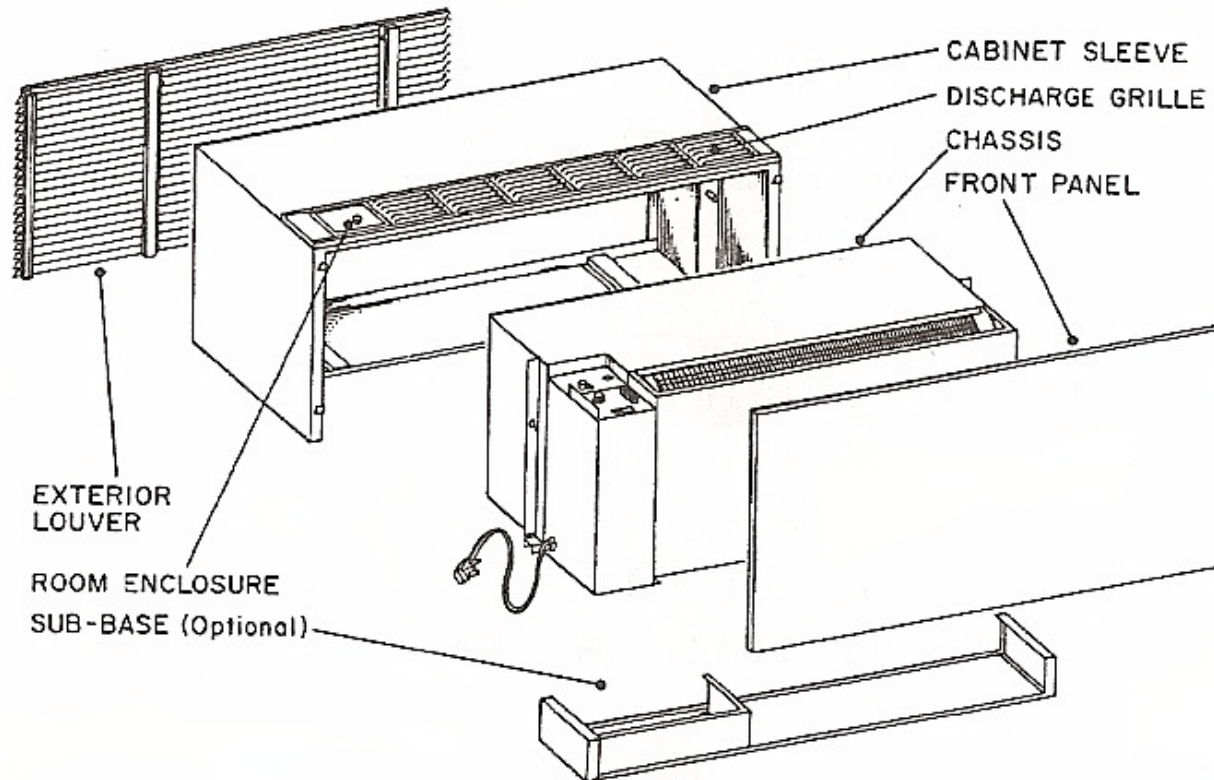


Fig. 14-10 Packaged Terminal Air Conditioner with Combination Heating and Cooling Chassis

Source: Howell, Sauer, & Coad, Principles of Heating, Ventilating, & Air Conditioning, 1997, Chapter 14.4

Cooling Systems

- Useful Factoids
 - 1 ton = 12,000 Btu
 - Approximately 400 cfm per ton
- Efficiencies
 - COP: Coefficient of Performance
 - consistent units at a specific operating condition
 - EER: Energy Efficiency Ratio
 - Btu-hr output/watt input at a designated operating condition
 - SEER: Seasonal Energy Efficiency Ratio
 - Btu-hr output /watt input over the cooling season
 - HSPF: Heating Season Performance Factor
 - Btu-hr output/watt input over the heating season

In Summary

Questions and Discussion

Next Class

- Air Processing Equipment
 - Air Handlers & Coils
 - Evaporative cooling
 - Dehumidification/humidification
 - Air Cleaners
 - Heat Recovery
- Readings
 - HF Chapter 10 (review)
 - Handout