

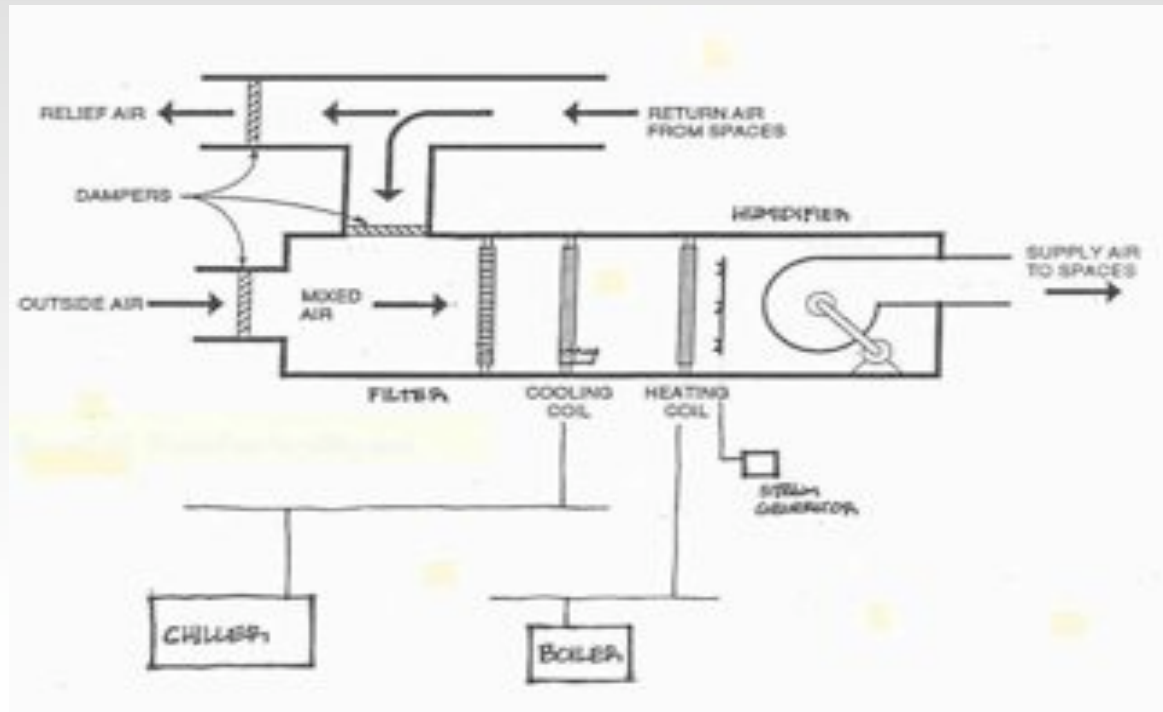
# How Preservation Environments Use Energy

Minnesota History Center, Saint Paul, Minnesota  
December 6-7, 2010

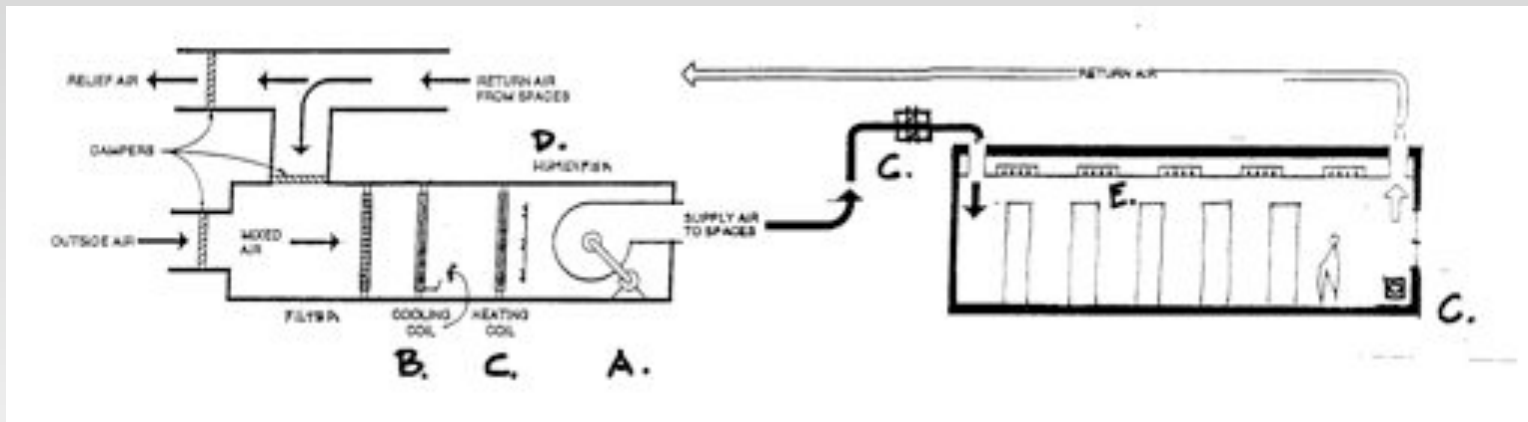


# Energy-Consuming Components of HVAC Systems

- Air Handling Unit and Sources of: Cooling / Heating / Humidification



# Energy-Consuming Components of HVAC Systems

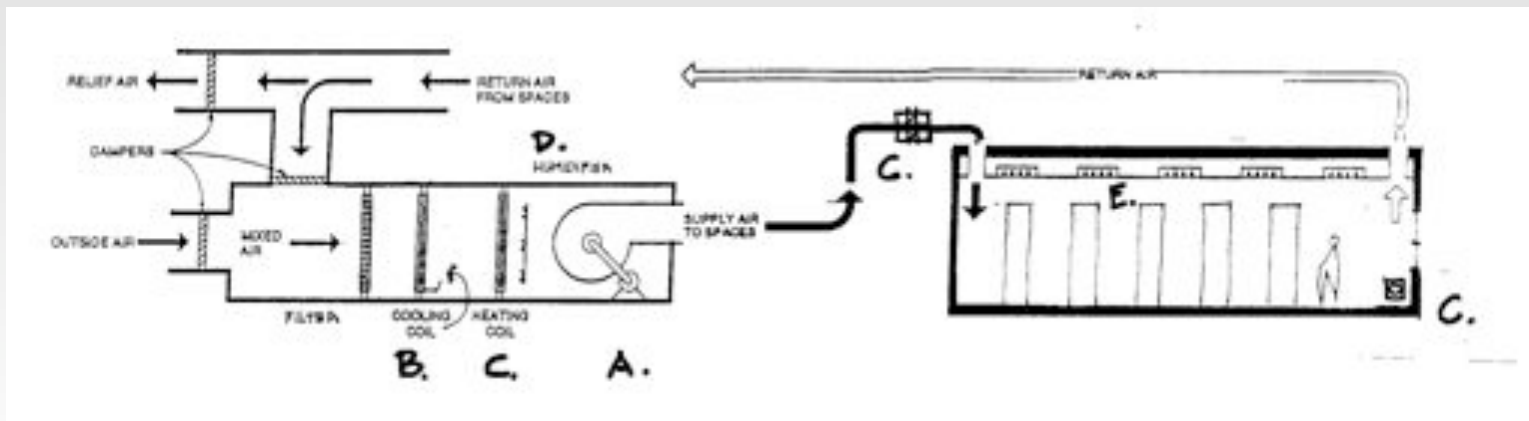


## Components:

- A. Air Handling Fans
- B. Cooling/Dehumidification
- C. Heating/Reheating
- D. Humidification
- E. Lights

# Energy-Consuming Components of HVAC Systems

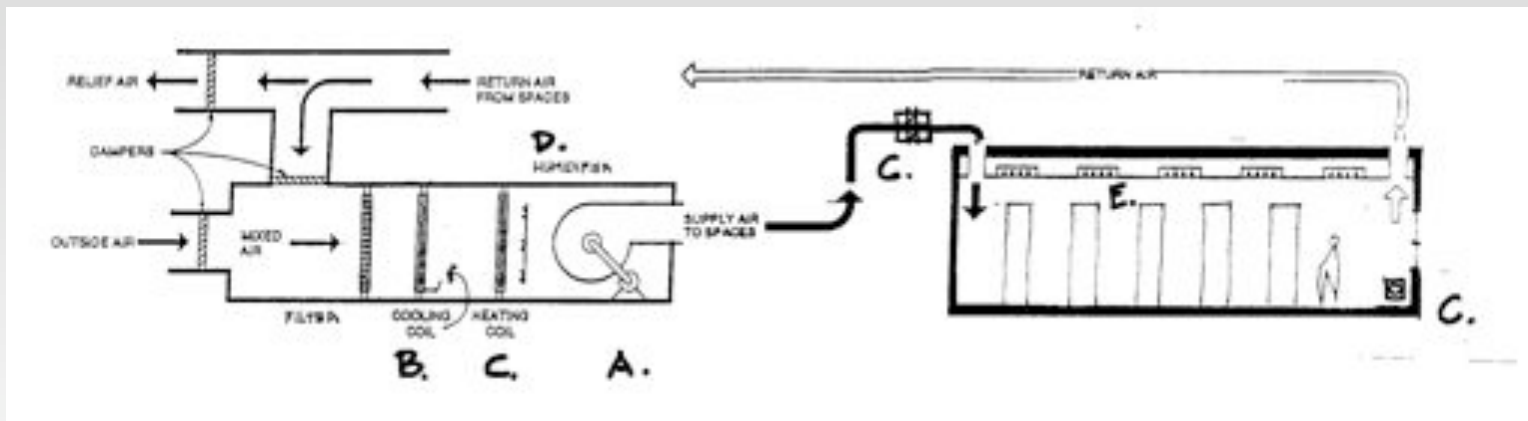
## Operating Variables that Affect Energy Consumption



**Energy = Rate of Consumption x Time of Operation**

# Energy-Consuming Components of HVAC Systems

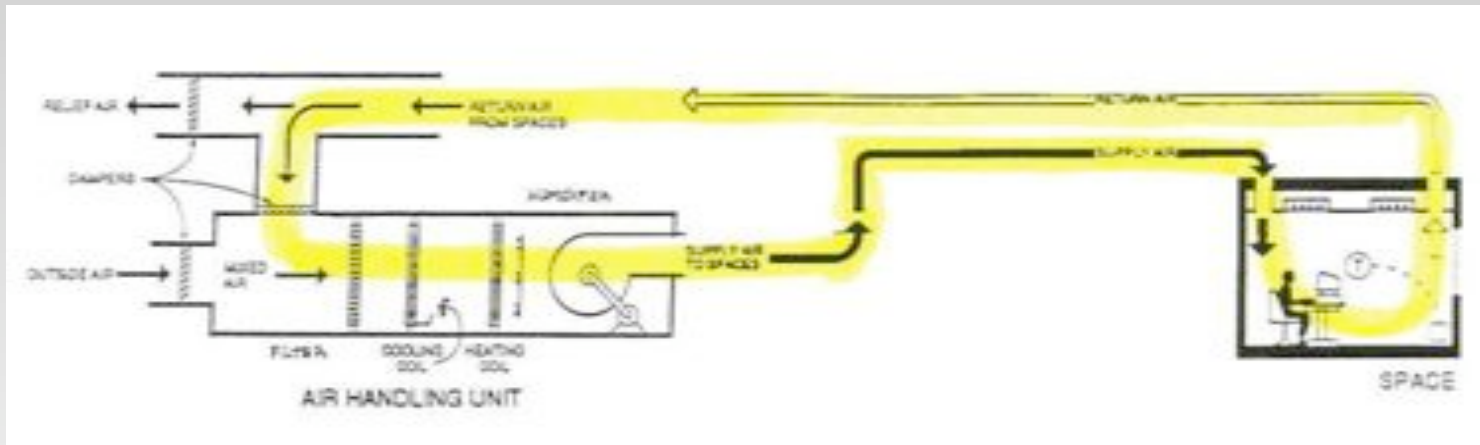
## Operating Variables



A Air Handling Fans – Operating Drivers  
Total Air Flow (VAV)  
Schedule of Air Flow

# Operating Variable – Total Air Flow

## Example Air Change Calculation



Storage space area = 5,000 SF

Storage space ceiling height = 8 FT

Storage space volume = 5000 SF x 8 FT = 40,000 Cubic Feet (CF)

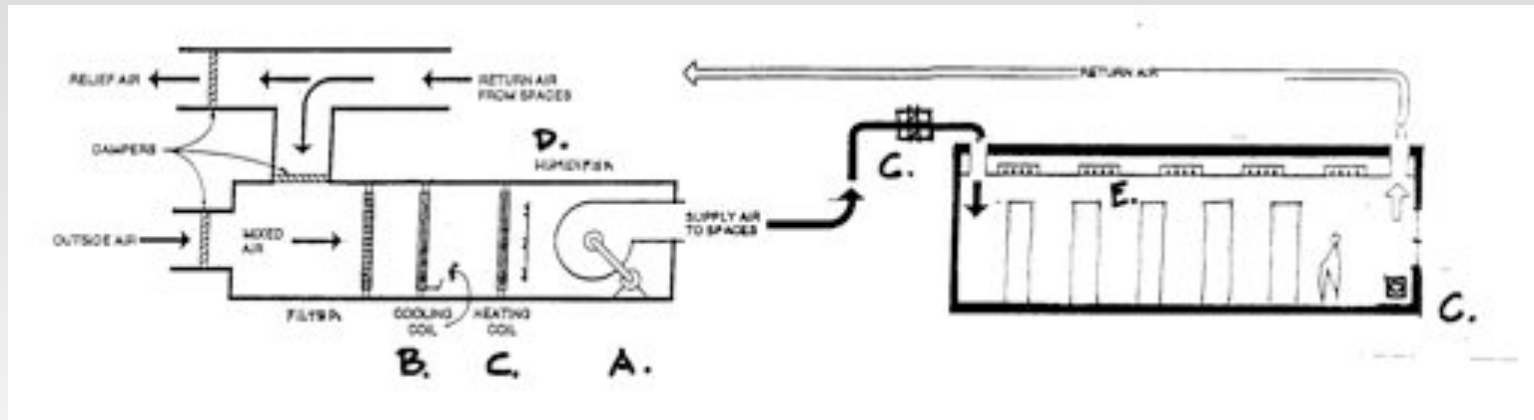
Supply air is 5,000 CFM x 60 minutes = 300,000 CF per Hour

300,000 CFH divided by 40,000 CF = **7.5 Air Changes per Hour**

At 10% OA = 0.75 Air Changes/Hour = **1 Outside Air change every 1.3 Hours**

# Energy-Consuming Components of HVAC Systems

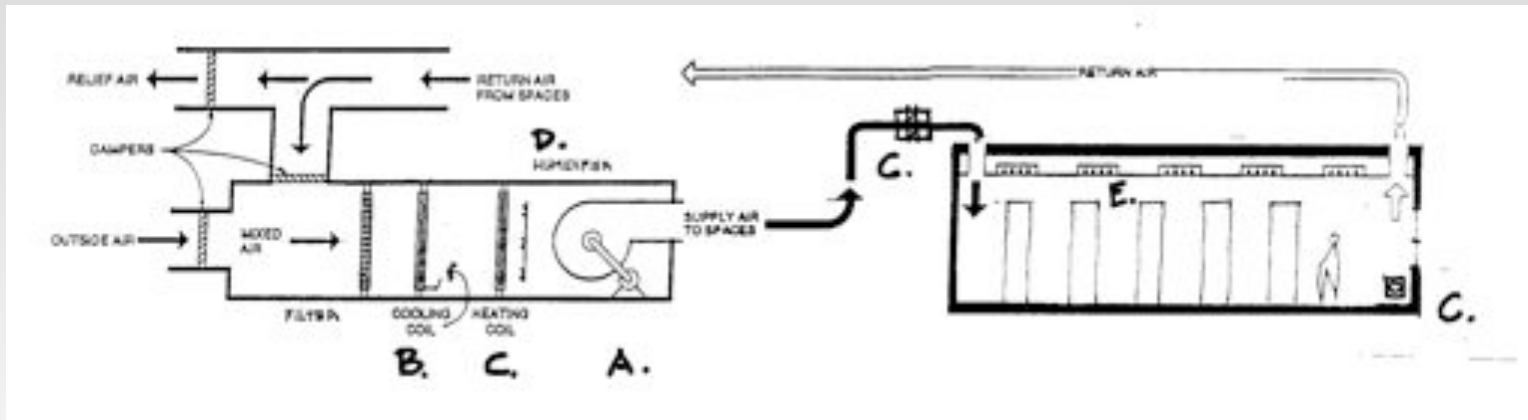
## Operating Variables



**B** Cooling/Dehumidifying – Operating Drivers  
**Temp. and RH Setpoints & Schedule**  
**Quantity of Outside Air & Schedule**  
**Space Loads (Lighting)**  
**Total Air Flow**

# Energy-Consuming Components of HVAC Systems

## Operating Variables

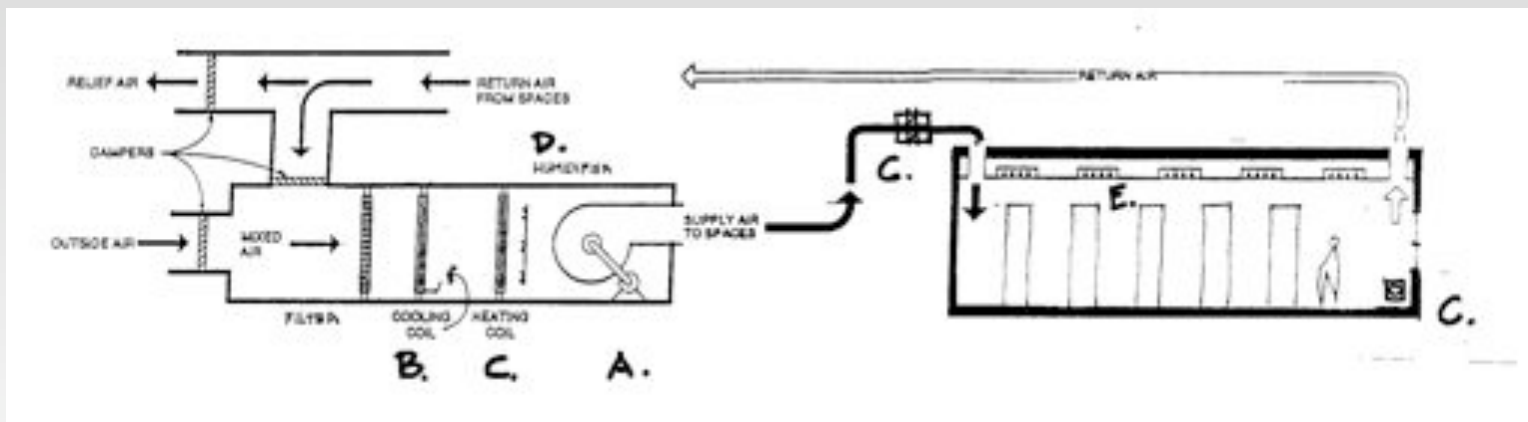


- C Heating/Reheating – Operating Drivers
  - Temp. Setpoint & Schedule
  - Quantity of Outside Air & Schedule
  - Seasonal Control
  - Total Air Flow & Schedule



# Energy-Consuming Components of HVAC Systems

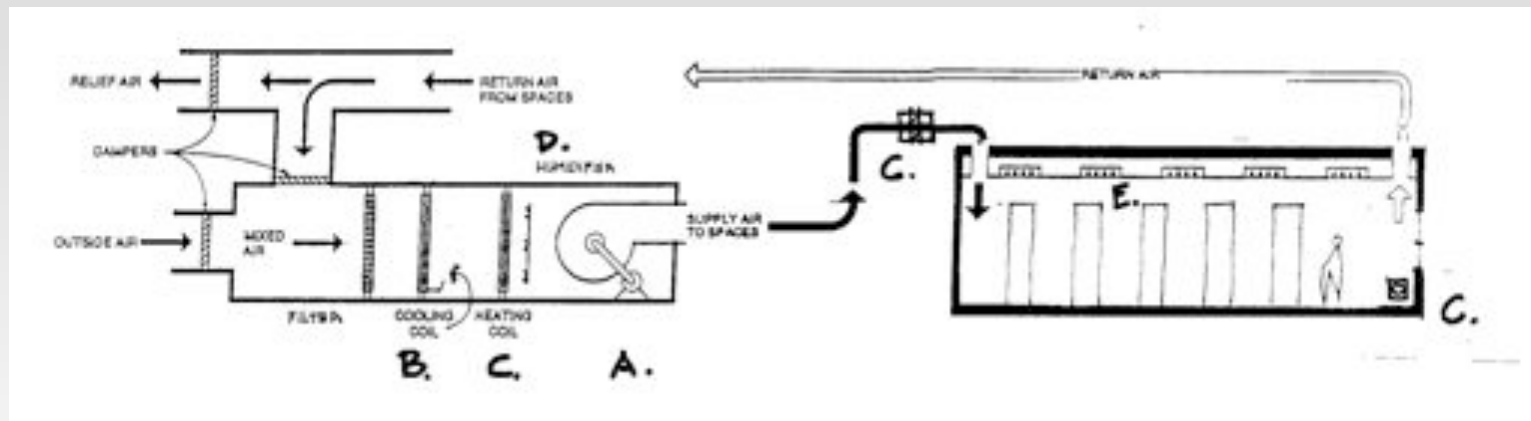
## Operating Variables



**D Humidifying – Operating Drivers**  
**RH Setpoint**  
**Quantity of Outside Air & Schedule**

# Energy-Consuming Components of HVAC Systems

## Operating Variables



E Lights – Operating Drivers  
**Schedule (hours of operation)**

# Example Allocation of Storage Area Annual Energy Cost

Component	% of Annual Energy Cost
<b>A. Air Handling Fans</b>	<b>19%</b>
<b>B. Cooling Coil</b>	<b>30%</b>
<b>C. Heating Coil</b>	<b>40%</b>
<b>D. Humidifier</b>	<b>5%</b>
<b>E. Lighting</b>	<b>6%</b>

# Energy-Consuming Components of HVAC Systems Operating Variables

## Summary of Operating Variables:

Total air flow and schedule

Temperature and RH setpoints and schedule

Quantity of outside air and schedule

Space Loads (Lighting)