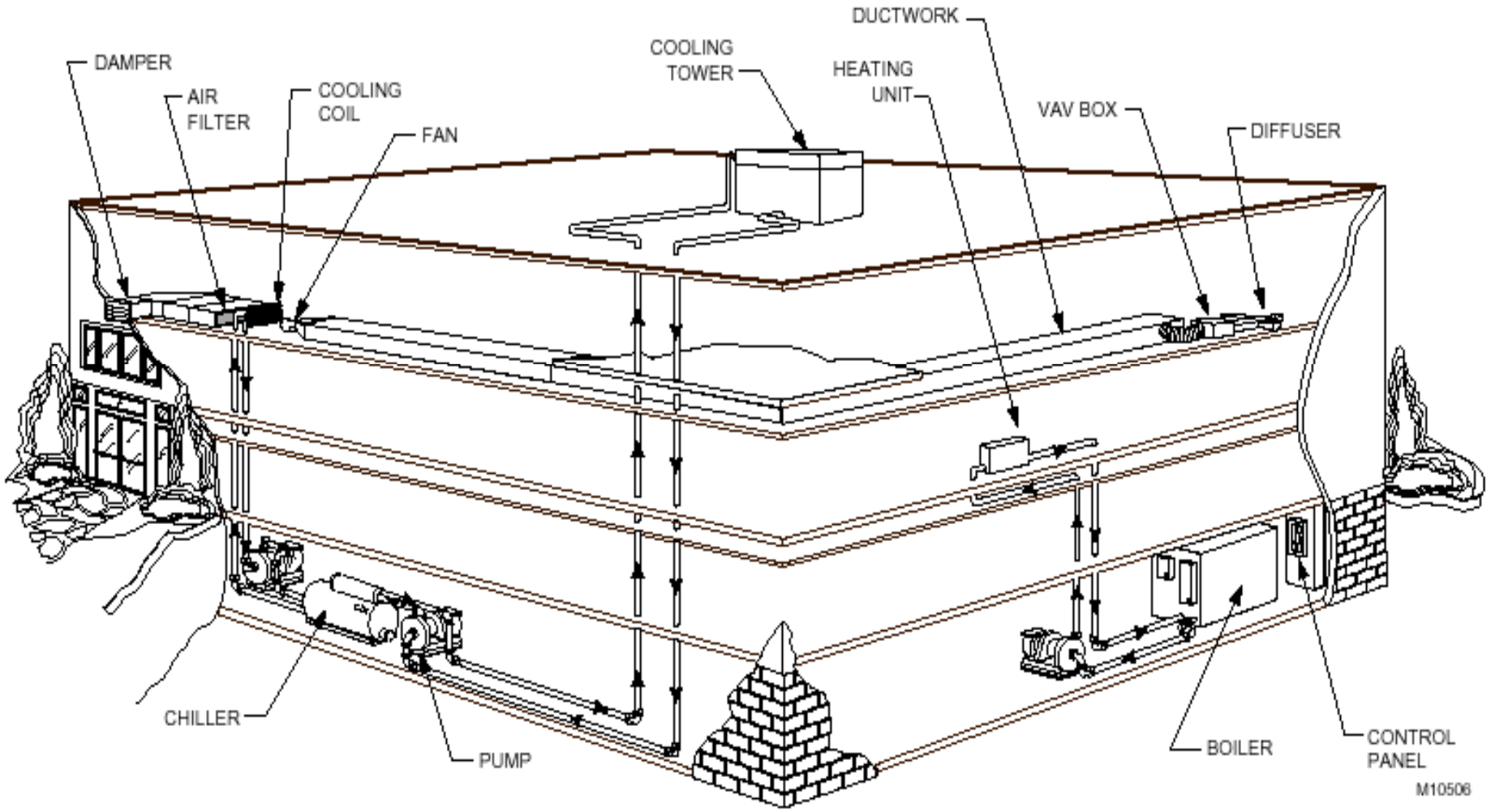
AHU
Air Handling Unit
Fundamentals

Objectives

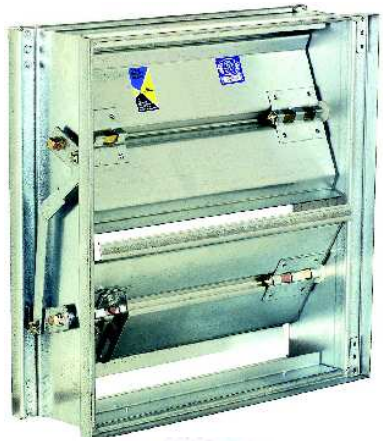
- Review primary components of an AHU
- Understand the basic progression and advantages of advanced AHU control
- Understand the basic control sequences
- Review key operating concepts

HVAC System *in a Building*

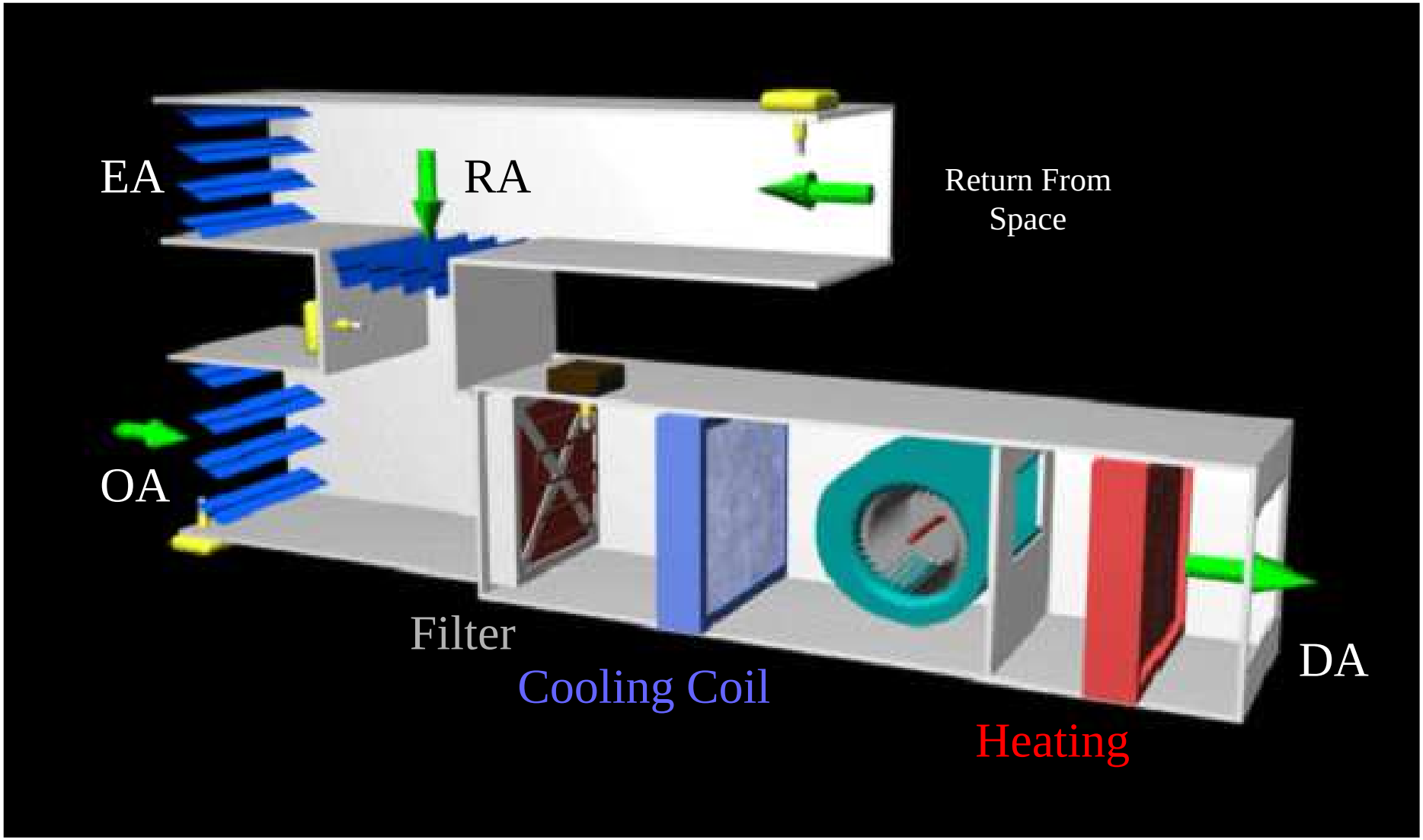


HVAC Air Systems

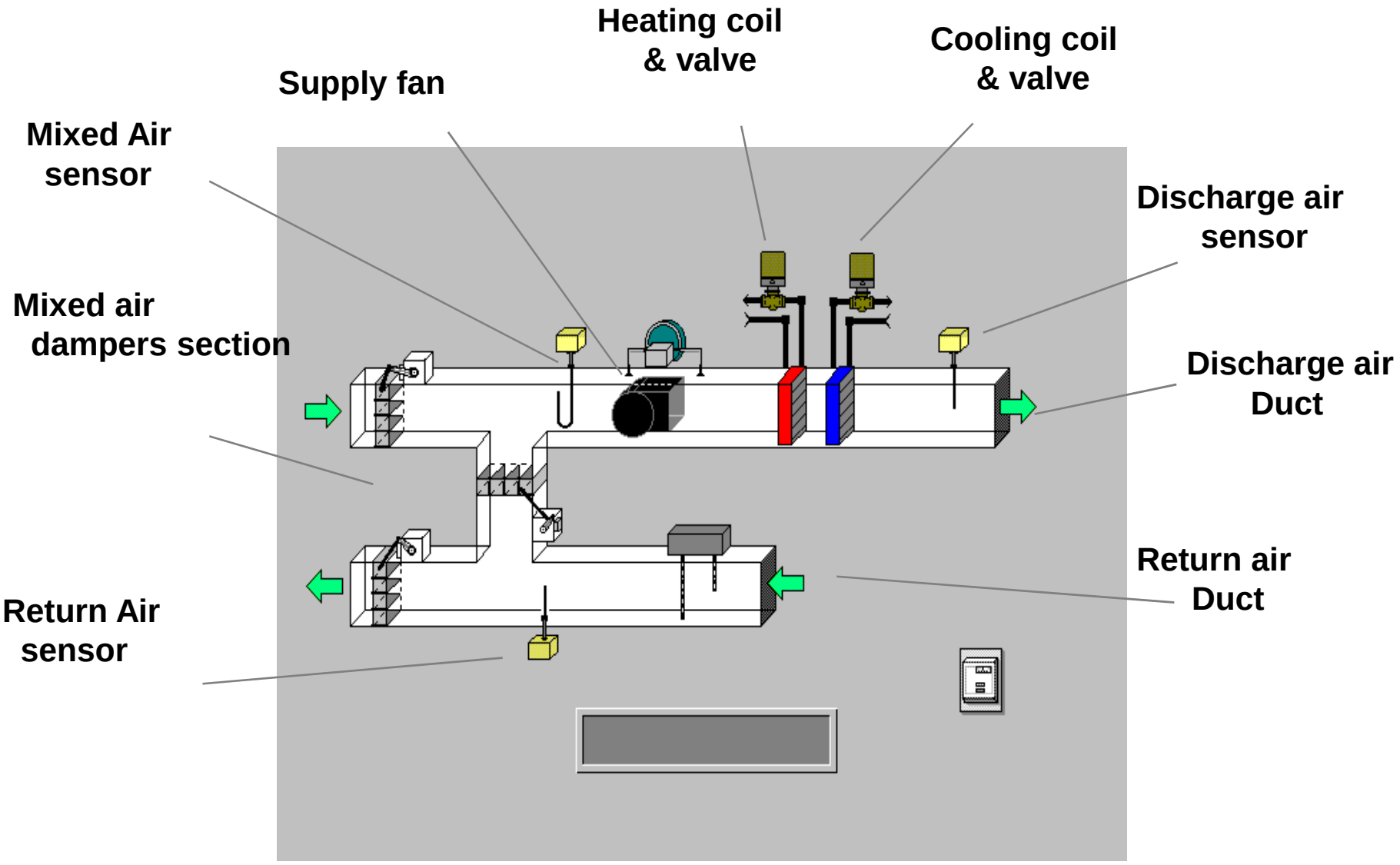
- HVAC air systems are made up of:
  - AHU - Air handling units
  - Dampers
  - Coils and Valves
  - Fans
  - Distribution ducts and terminal boxes
  - Pumps and Plumbing
  - Control devices and control loops
  - Unitary equipment: fan coils, perimeter radiation, unit ventilators, unit heaters, etc.



AHU - Components & Terminology



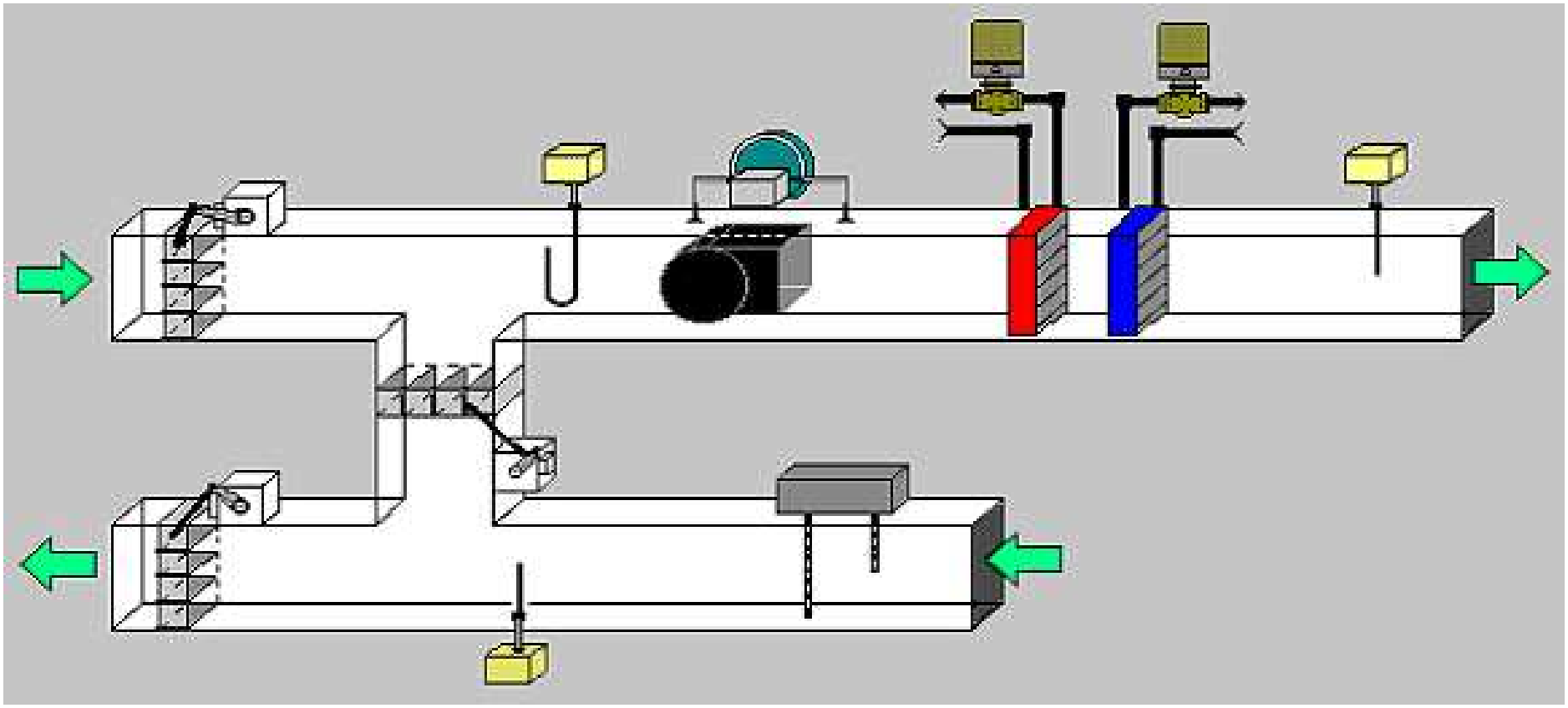
AHU components



AHU components

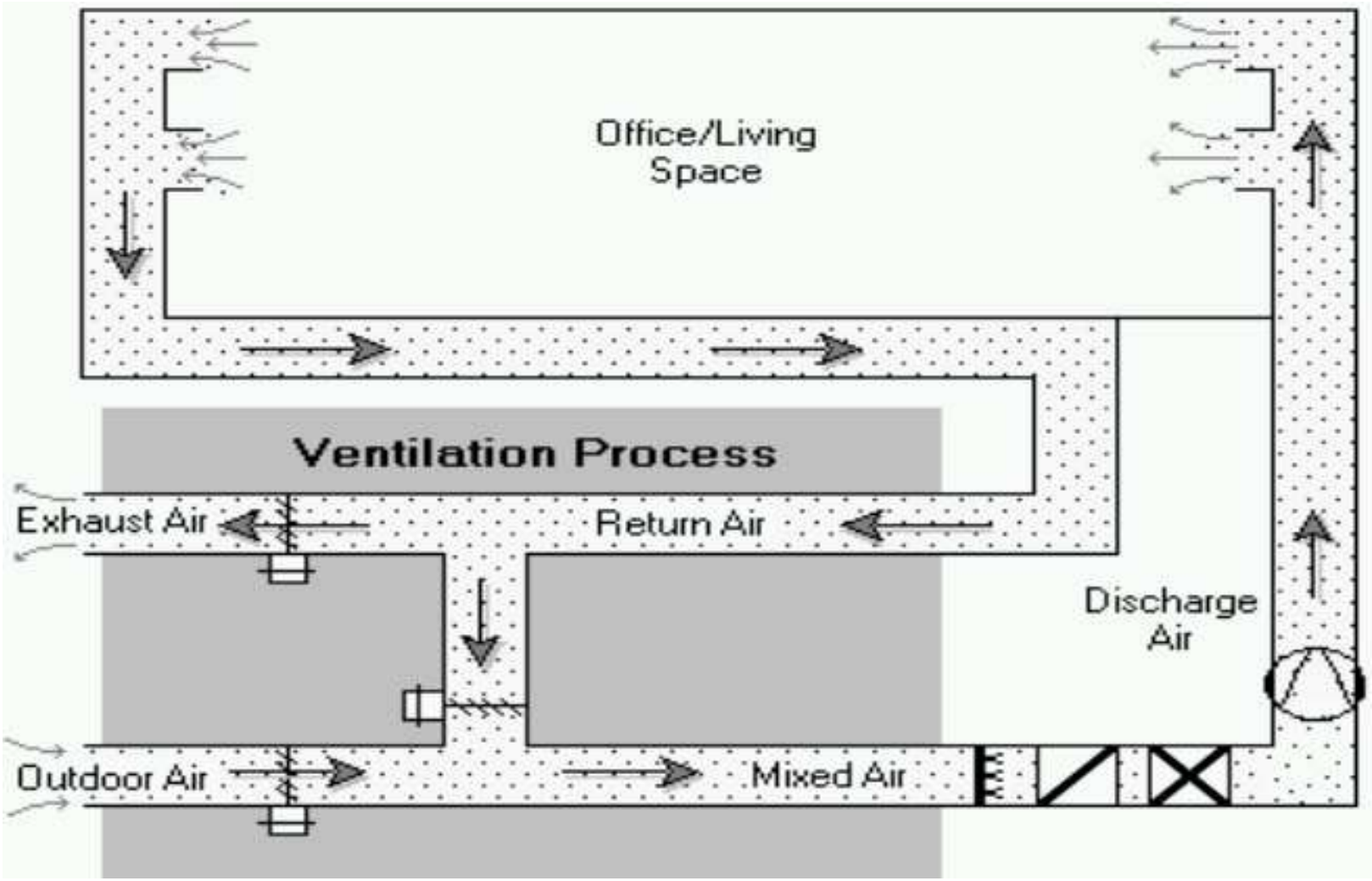
Types of Air Handlers

Air Handling Units – Mixed Air



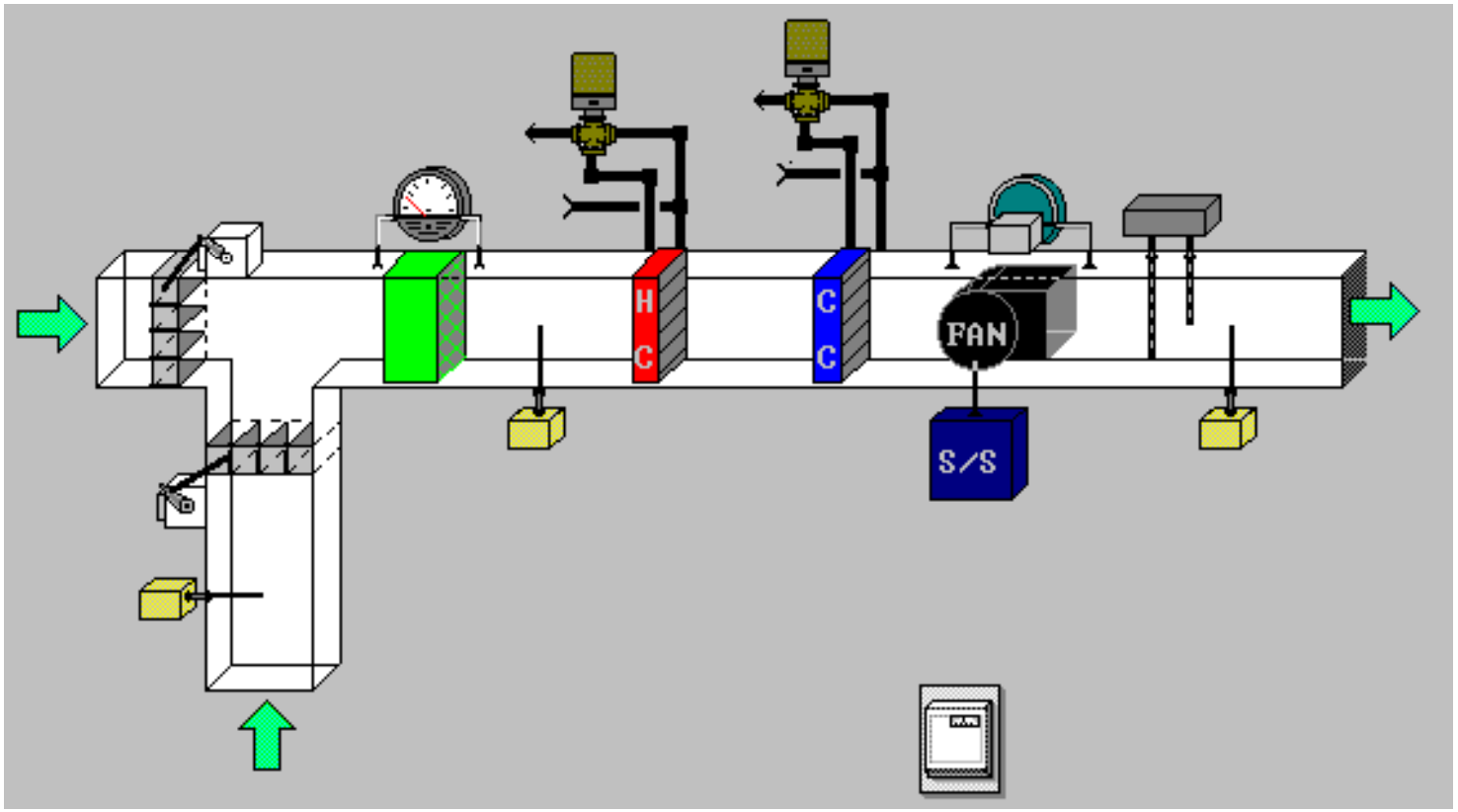
Types of Air Handlers

Air Handling Units – Mixed Air



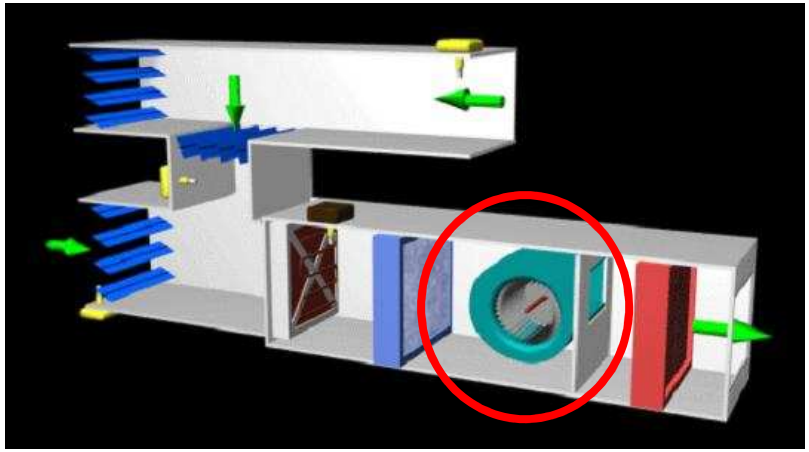
A “Single Duct” AHU *variation*

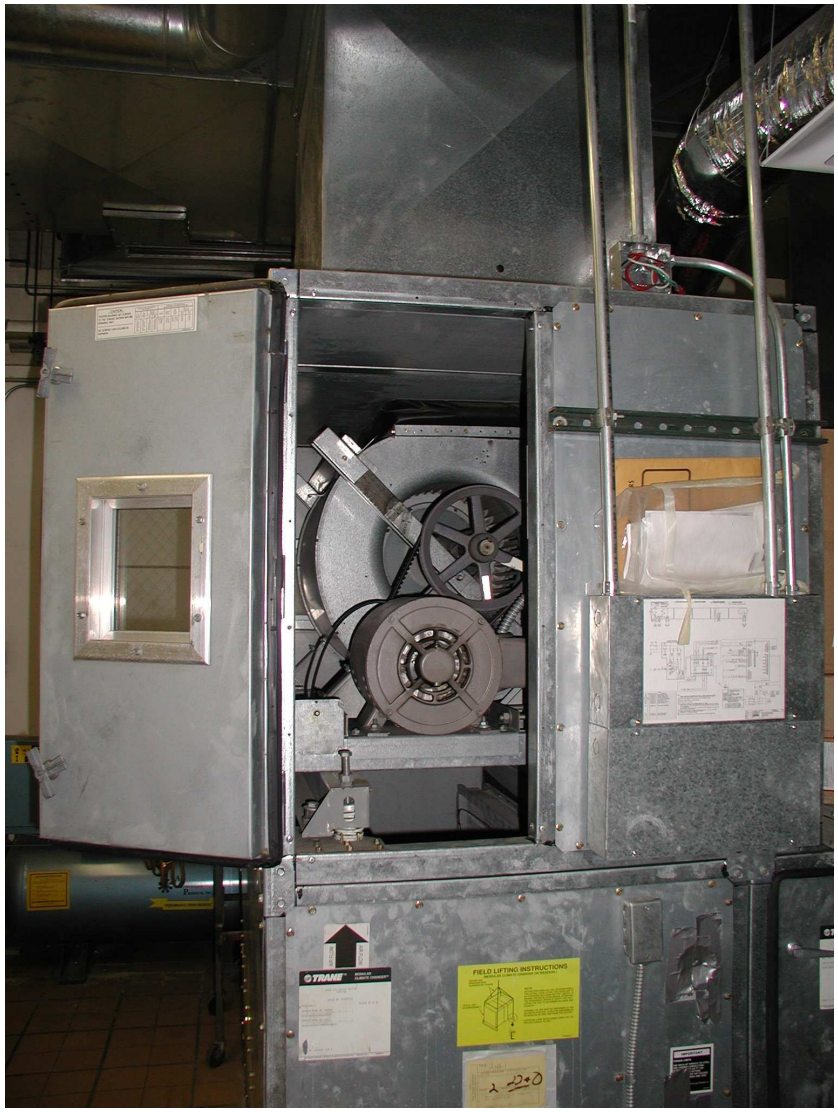
- The exhaust air damper is not in this air handler; the building air is exhausted elsewhere, but the basic mixed air and other functions are unchanged.



Air Handler Components

The fan section with access door open.





Air Handler Components

The filter section.

Notice the cross stacking of the filters to increase surface area.

Air Handler Components

Temperature Sensor:

- Temperature sensors are used for measurement of temperatur of a Room, Air Duct, Hot /Cold Water, Outside Air etc.
- Models are available with PT1000, NTC20K, BALCO500 sensing elements.

LF20 : AIR DUCT TEMP. SENSOR (NTC 20k)

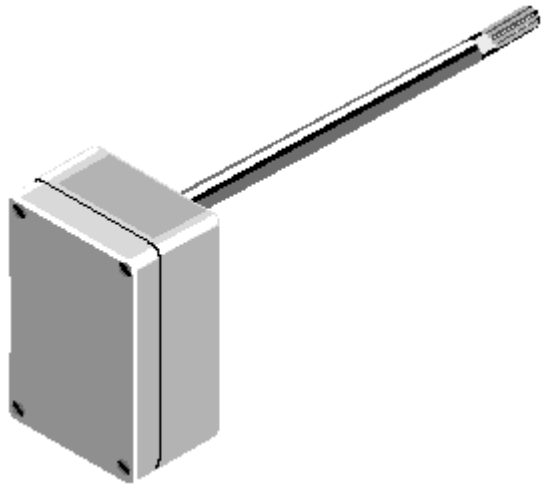
T7412 : ROOM TEMP. SENSOR (PT1000/NTC 20k)

T7413A : IMMERSION TEMP. SENSOR (PT1000)

Air Handler Components

Relative Humidity Sensor:

- Relative Humidity sensors are used for measurement of Relative humidity of a Room, Air Duct, Outside Air etc.
- Sensor Type : Capacitance
- Combined Relative Humidity and Temperature Sensors are available with PT1000, NTC20K, BALCO500 sensing elements.



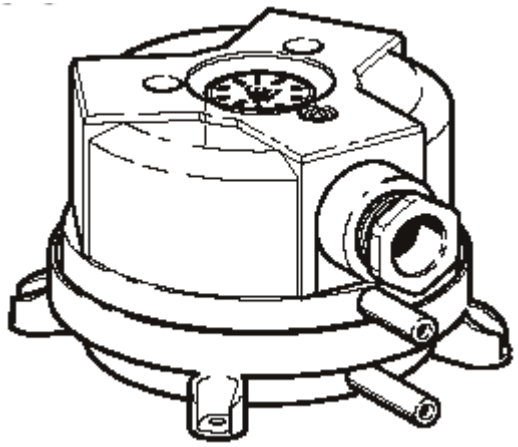
H7015 : DUCT RELATIVE HUMIDITY SENSOR

H7012 : ROOM RELATIVE HUMIDITY SENSOR

Air Handler Components

Differential Pressure Switch:

- Differential Pressure switches are used for monitoring of Filter, Fan, Pump, Fire Damper, Water Flow, Air Flow Status of air handling systems.



DPS1000 : AIR DIFFERENTIAL PRESSURE SWITCH

TDIAP SERIS : AIR FLOW SWITCH

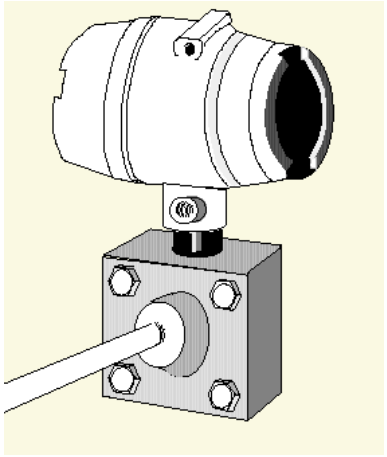
Air Handler Components

Differential Pressure Sensors/Transmitter:

- Used for measuring diff. Pressure, positive pressure and vacuum.

DPT250-2500 DPT250D-2500D

DPT1000 : AIR DIFF. PRESSURE TRANSMITTER



ST 3000 Pressure Transmitter

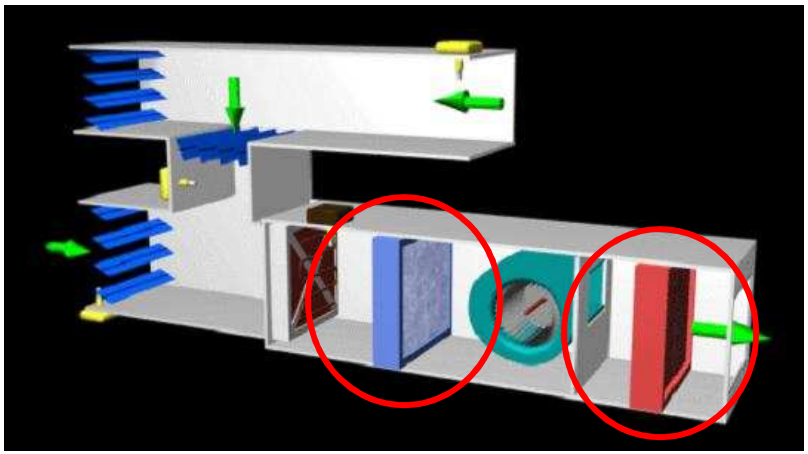
Air Handler Components

Coils :

Heating Coils
Cooling Coils

Coil Construction

- **Copper with Aluminium fins,**
- **13 Fins /inch**
- **Number of Rows, I.e 4/6/8 depending on the latent heat load & Bypass Factor.**



Air Handler Components

The coil section of a AHU.

Note:
There may be a wide
variety of actual configurations

Air Handler Components

Valves & Actuators

Valve Types

- **2 Way or 3 Way**

Actuator Types

- **Motorised**
- **Magnetic**
- **Pneumatic**

Operation

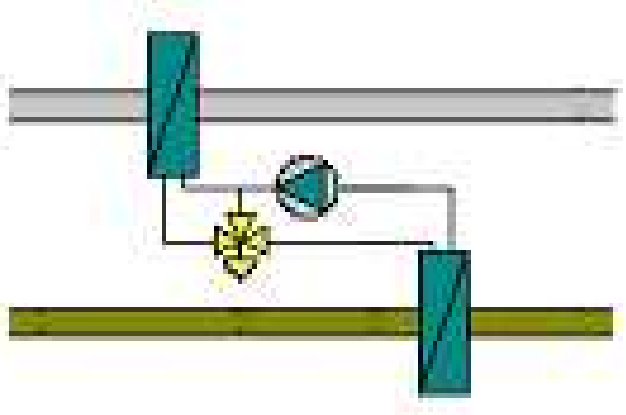
- **On - Off,Floating, Modulating**

Air Handler Components

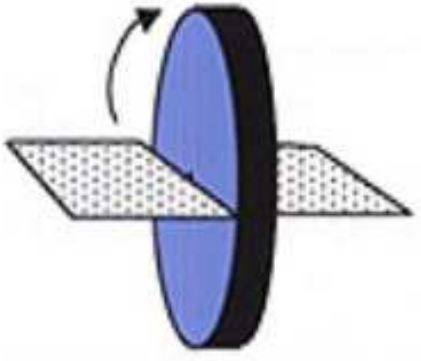
Heat Recovery :

A heat-recovery system is often used in buildings where a significant quantity of outdoor air is used. Several types of heat-recovery systems are available

- **Heat pumps**
- **Runaround systems**
- **Rotary heat exchangers**
- **Heat pipes.**



Runaround systems

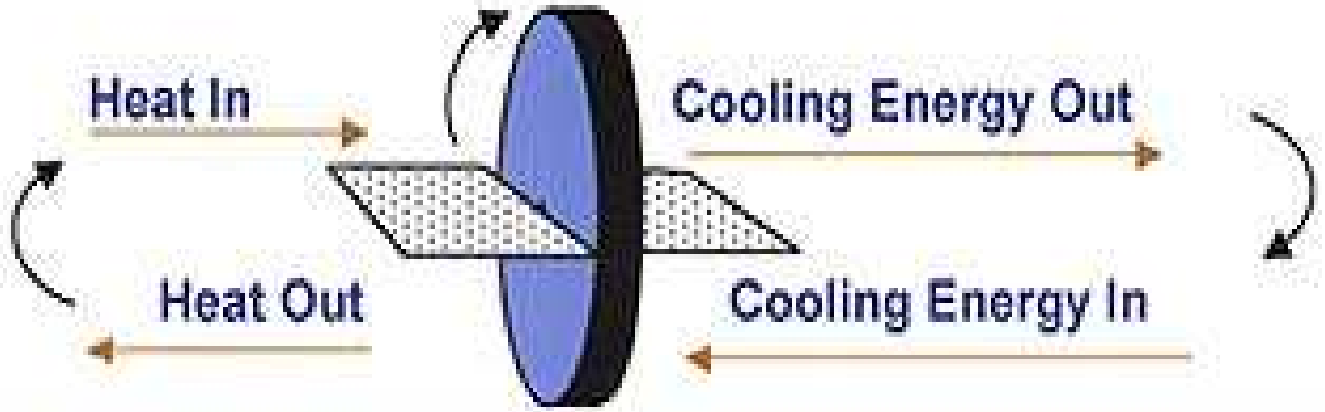


Heat Wheel

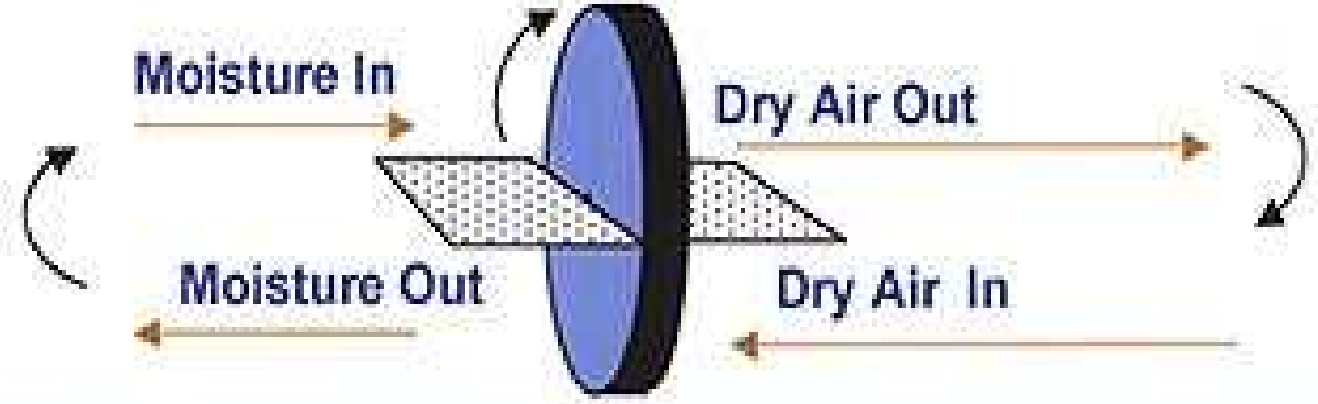
Air Handler Components

Heat Recovery : Heat Wheel

1. Heating/Cooling Energy (e.g. 80%) Is Always Returned To Where It Came From

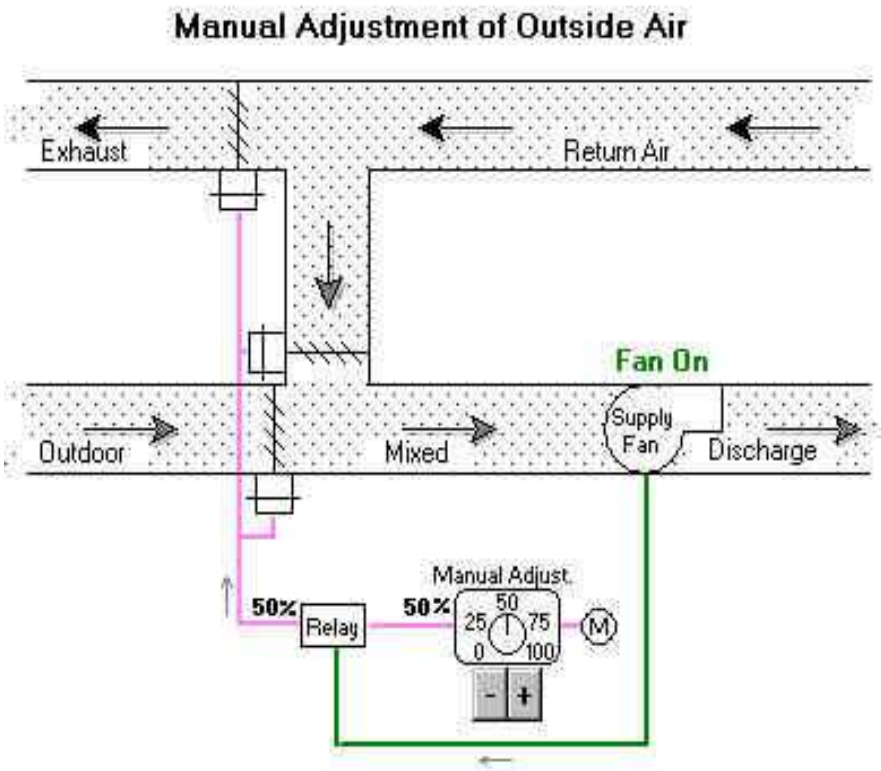


2. Moisture and Dry Air (e.g. 80%) Is Always Returned To Where It Came From



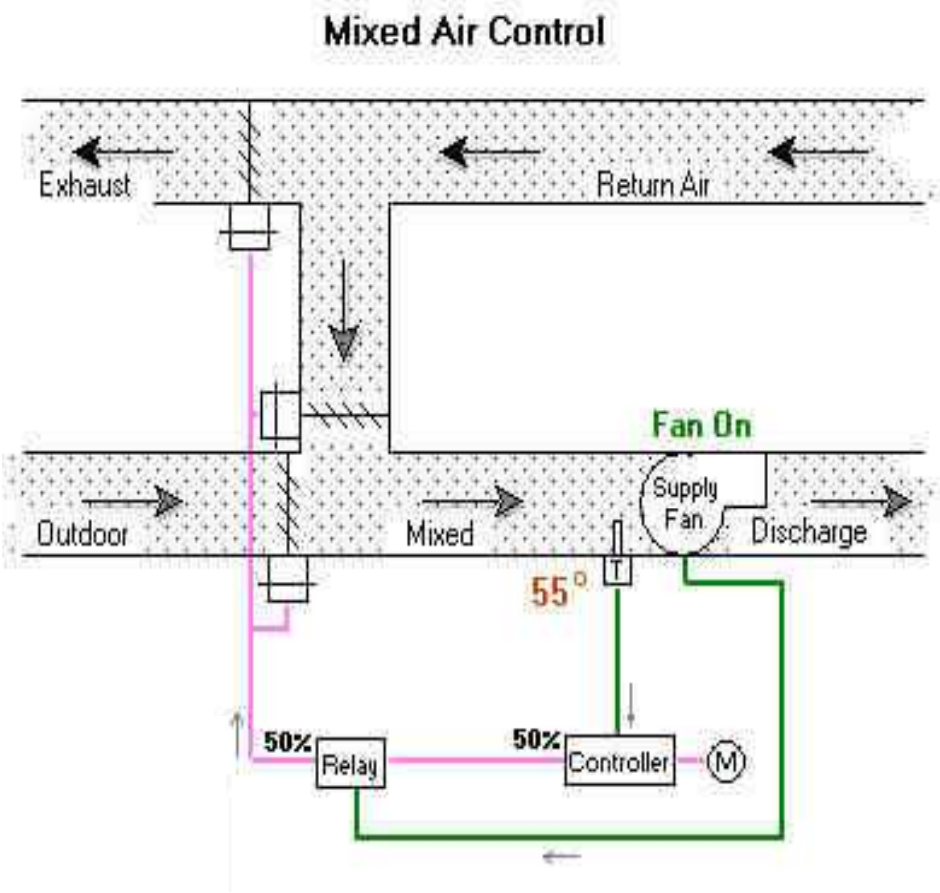
Typical AHU Damper Sequences

- Manually adjustable quantity of outdoor air:
- Similar to “Fixed”, but with a user adjustment device for adjusting damper setting from 0% to 100% outdoor air.
- No automatic control.
- W/WO exhaust or return air ducts.



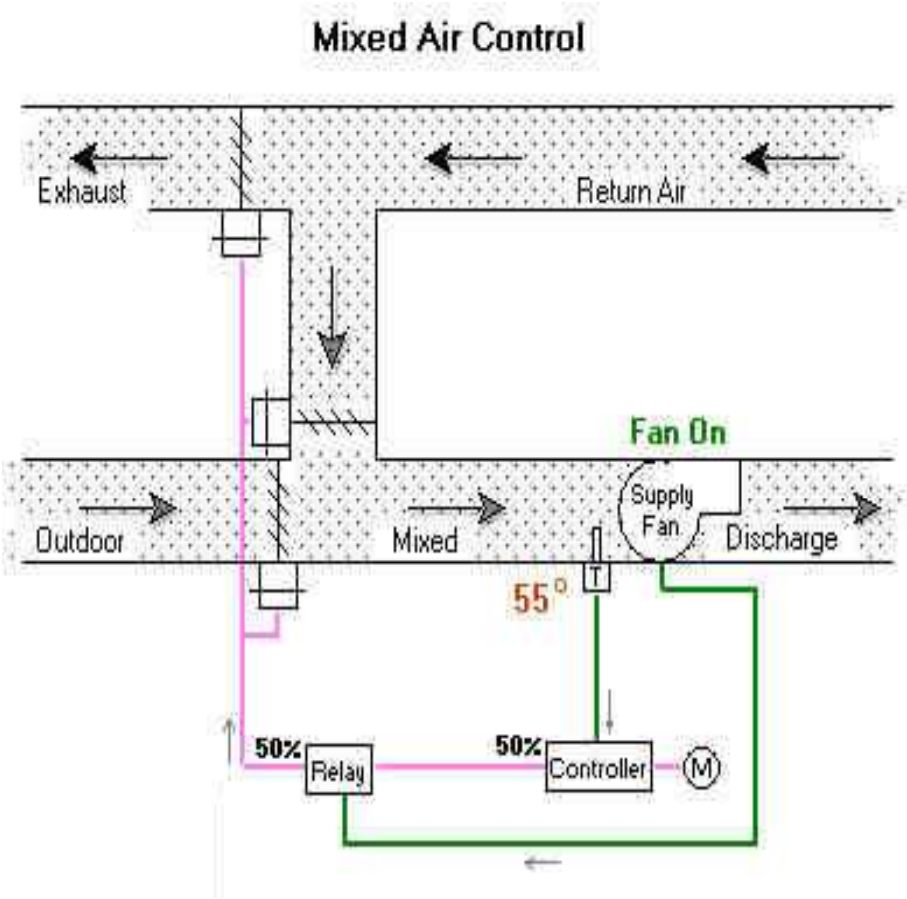
Typical AHU Damper Sequences

- <u>Mixed Air Dampers:</u>
- Mixes OA and RA to maintain a mixed air setpoint via direct acting controller.
- Modulates 0% to 100%.
- Provides ventilation for IAQ.
- Provides free cooling.
- Provides proper temperature for H/C coil operation.
- OA and EA dampers close via relay with fan off.
- RA damper opens via relay with fan off.



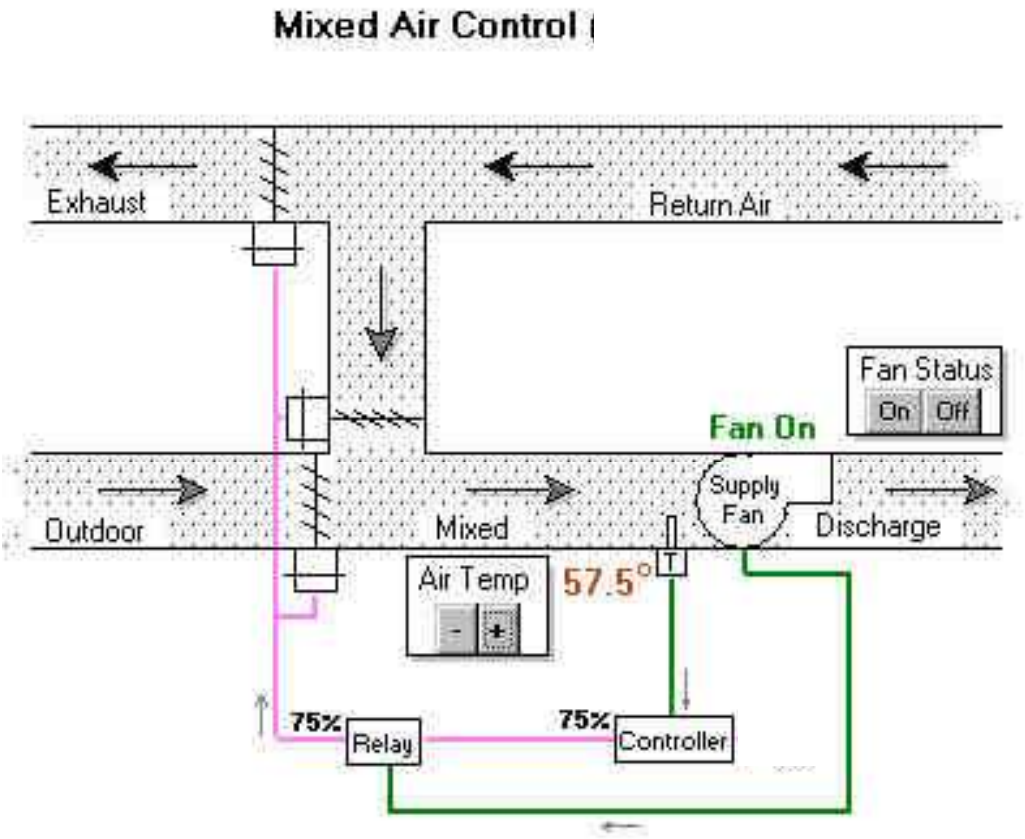
Typical AHU Damper Sequences

- Example of operation:
  - Setpoint = 55 deg.
  - MAT = 55 deg.
- Proportional Controller output = 50%
- Fan = On
- Dampers:
  - OA = 50%
  - RA = 50%



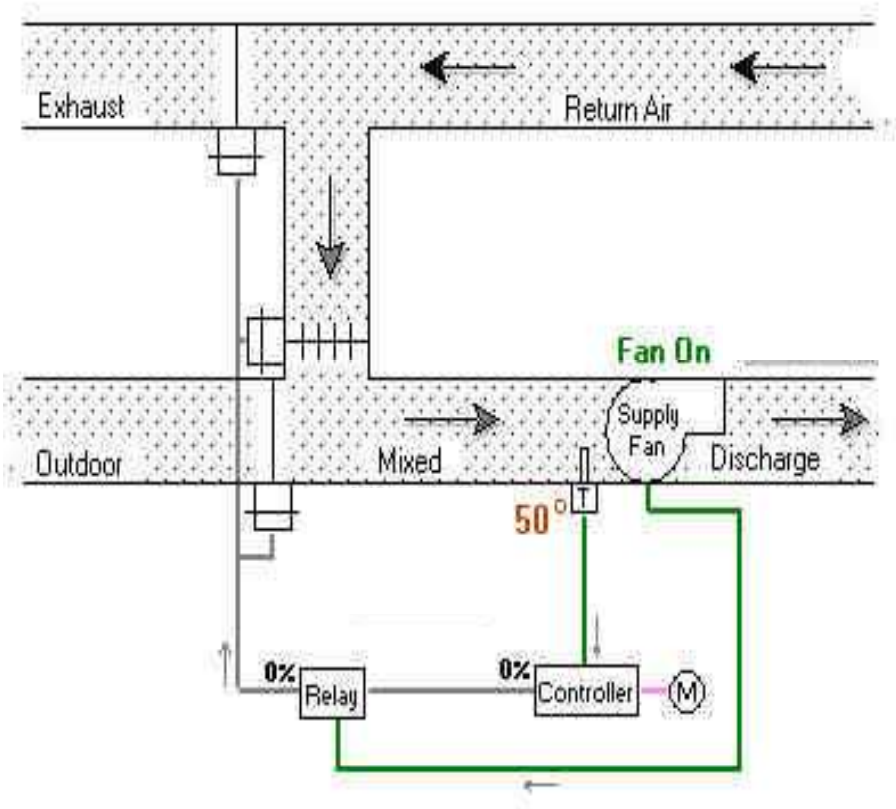
Typical AHU Damper Sequences

- Example of operation on temperature rise:
  - Setpoint = 55 deg.
  - MAT = 57.5 deg.
- Controller output = 75%
- Fan = On
- Dampers:
  - OA = 75%
  - RA = 25%
- More outdoor air!



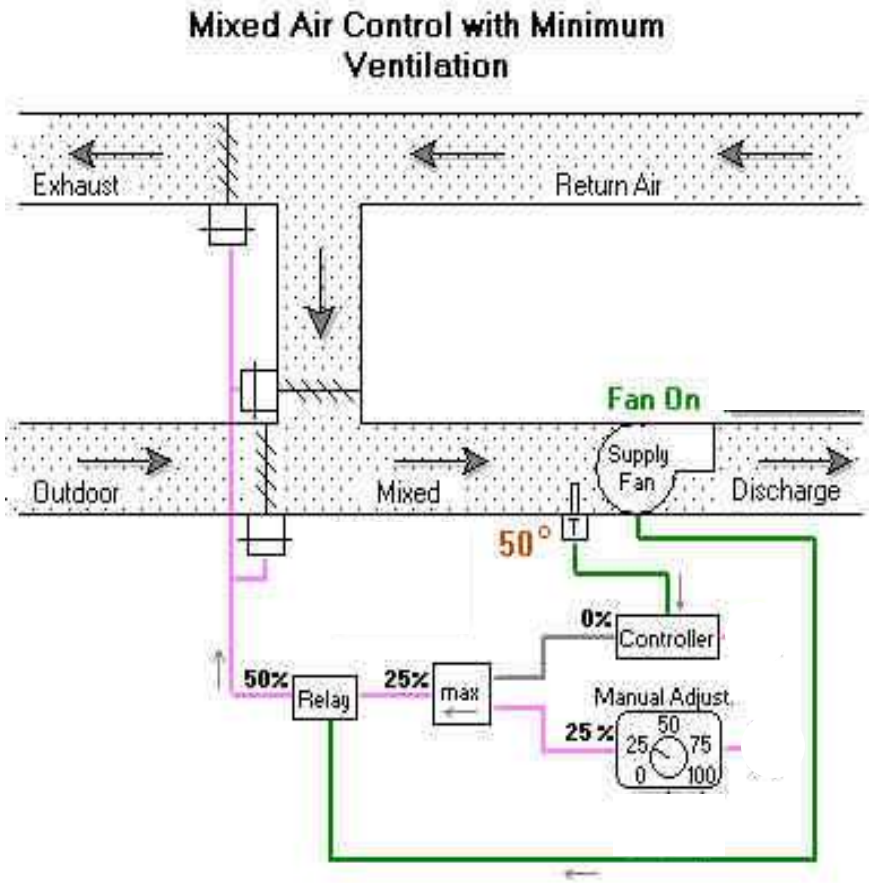
Typical AHU Damper Sequences

- Example of operation on temperature fall:
  - Setpoint = 55 deg.
  - MAT = 50 deg.
  - Controller output = 0%
  - Fan = On
- Dampers:
  - OA = 0%
  - RA = 100%
- No outdoor air; no fresh air in the building!



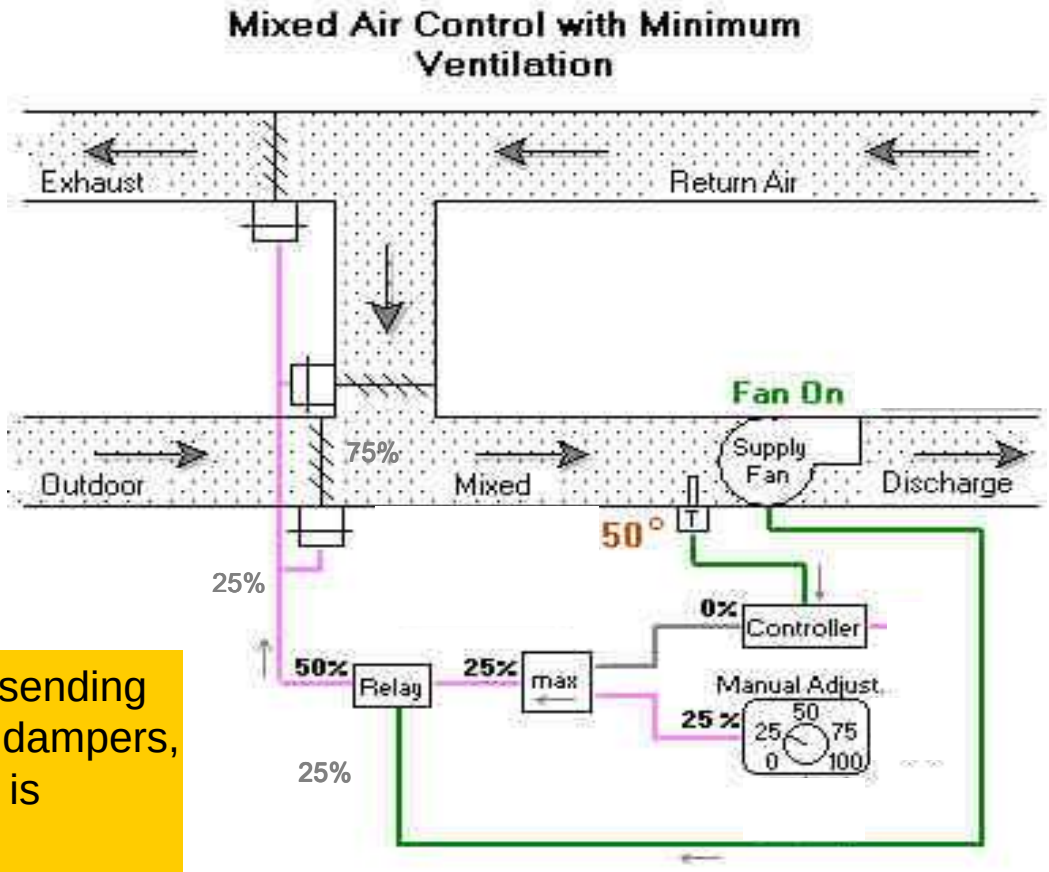
Mixed Air Dampers with a Minimum Position Setting

- Maintains a “minimum” outdoor damper position via a minimum adjustment device when building is occupied. (fan on)
- Meets IAQ code requirements.



Typical AHU Damper Sequences - Mixed Air

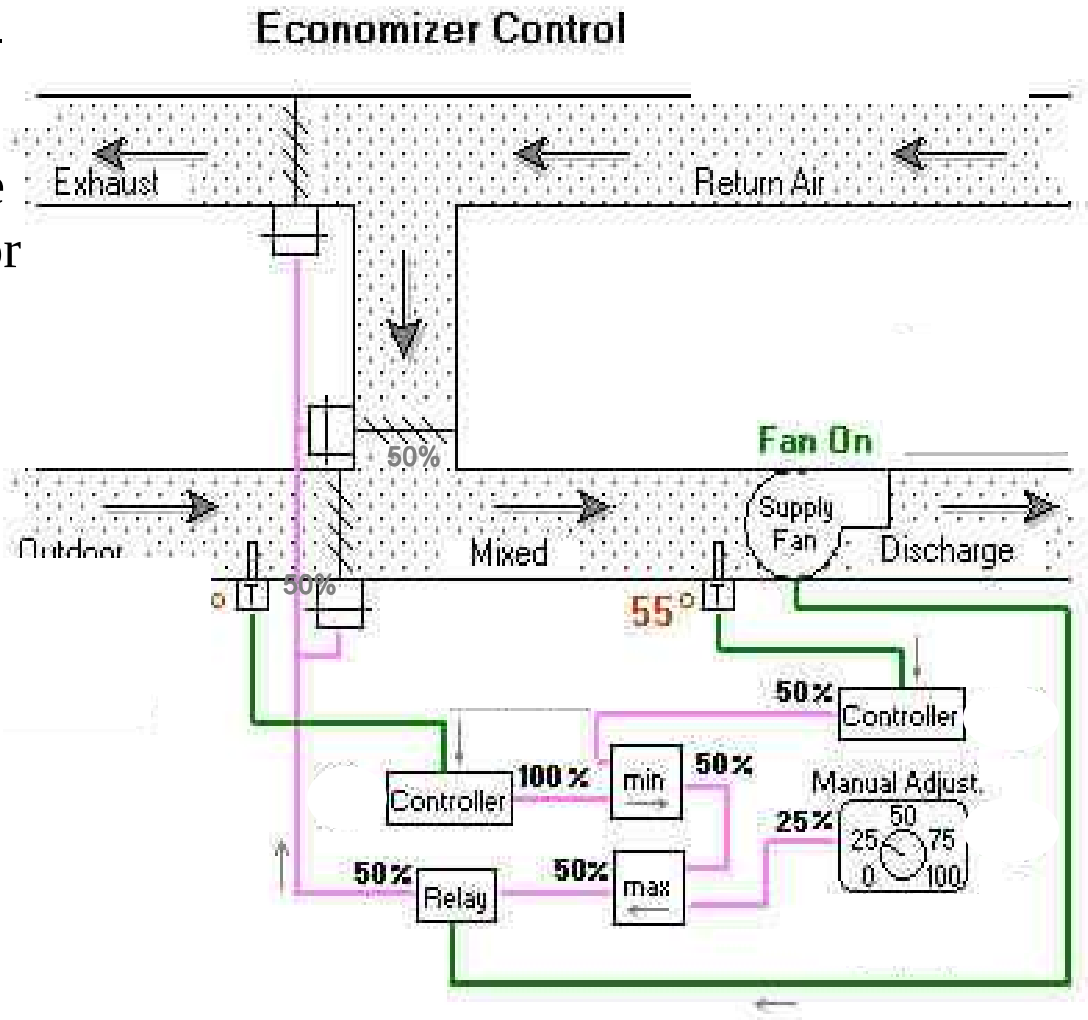
- Example of operation on temperature fall:
  - Setpoint = 55 deg.
  - MAT = 50 deg.
  - Controller output = 0%
- Min. Position Setpoint = 25%
- Fan = On
- **Dampers:**
  - **OA = 25%**
  - **RA = 75%**



Even though the Mixed Air controller is sending a control signal to completely close OA dampers, the minimum position controller or logic is maintaining setpoint.
Fresh air is maintained in the building!

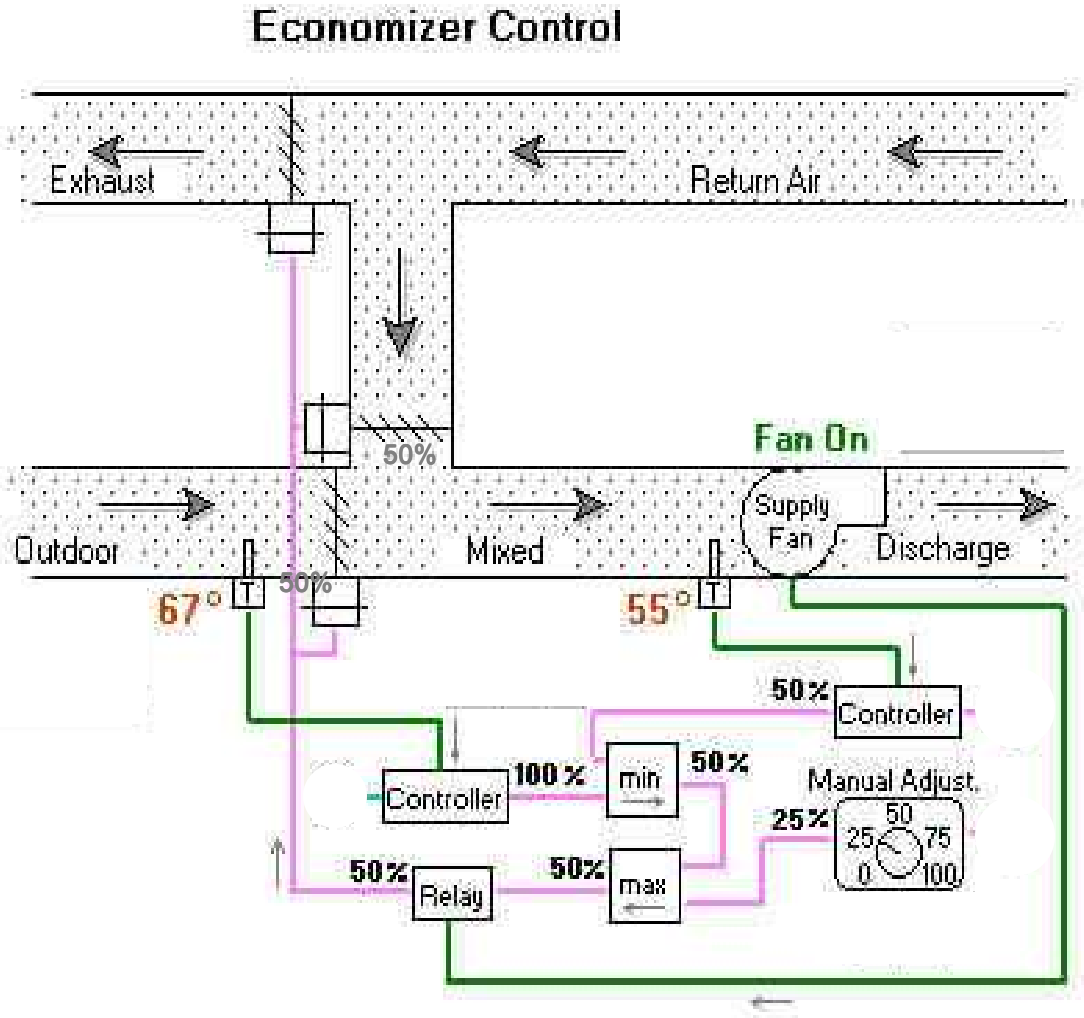
Typical AHU Damper Sequences

- Economizer Override of Outdoor Air:
- Requires an additional reverse acting controller in the outdoor air.
- Brings OA damper to minimum when outdoor air temperature is high.
- Provides for economical operation of the cooling coil.



Typical AHU Damper Sequences

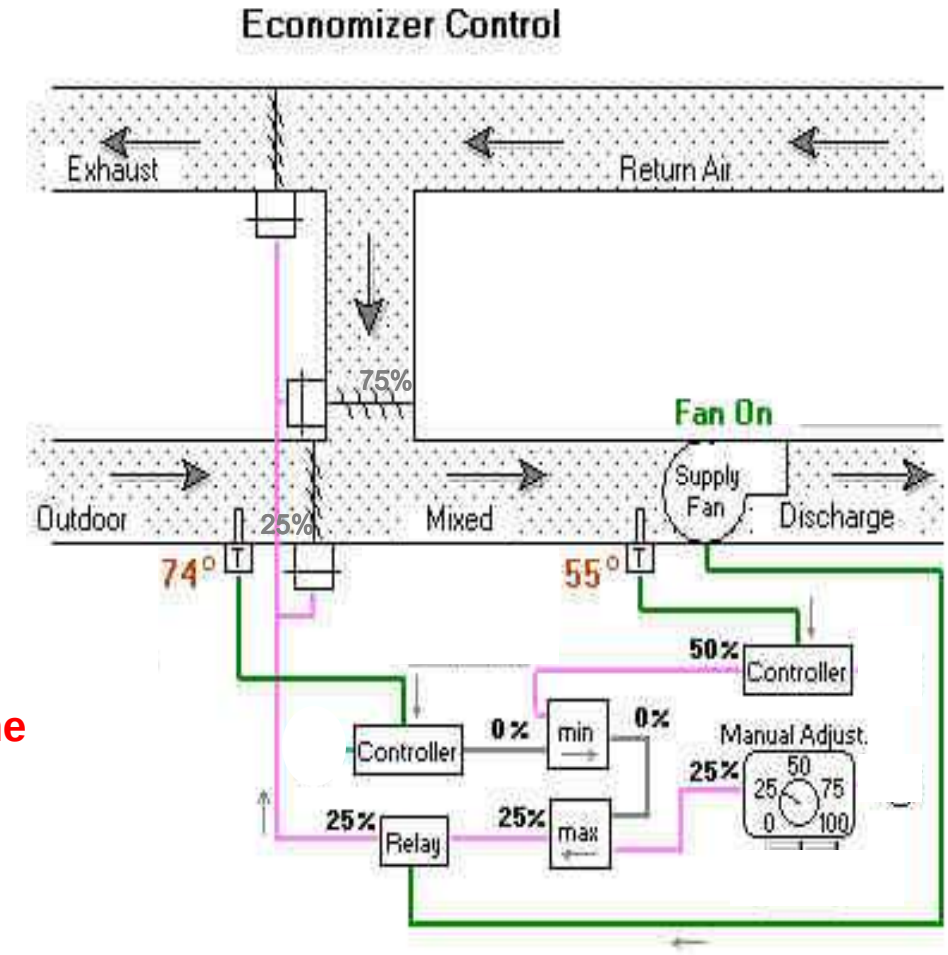
- Example of economizer operation with **low** outdoor temp.
  - MA StPt = 55 deg
  - MA temp = 55 deg
  - MA controller out = 50%
  - OA StPt = 70 deg
  - OA temp = 67 deg
  - OA controller out = 100%
- Min. Pos. StPt = 25%
- OA damper = 50%:
- MA controller is in control of
- the OA damper due to OAT acceptable for efficient use of mechanical cooling.



Typical AHU Damper Sequences

- Economizer Override with outdoor temperature **high**:
  - MA StPt = 55 deg
  - MA temp = 55 deg
  - ***MA controller out = 50%***
  - OA StPt = 70 deg
  - OA temp = 74 deg
  - ***OA controller out = 0%***
  - Min. Pos. StPt = 25%
- **OA damper = 25%:**

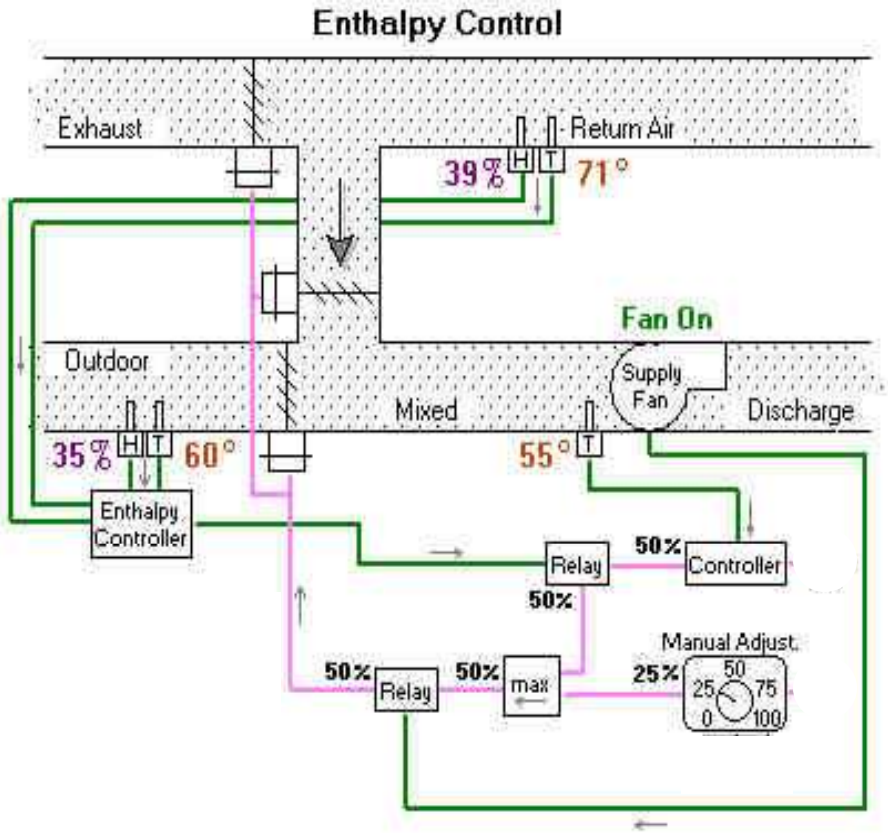
OA controller is in control of the OA damper due to OAT unacceptable for efficient mechanical cooling.



Typical AHU Damper Sequences

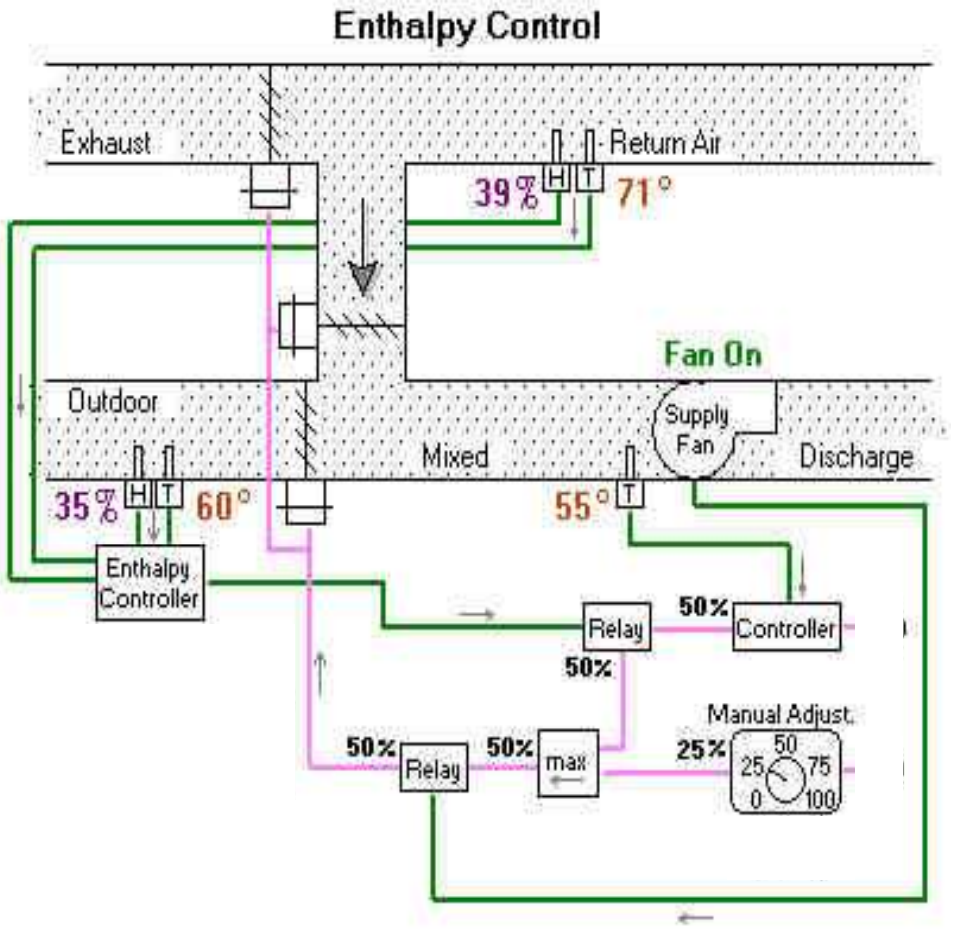
- Enthalpy controlled override of Mixed Air control:

- Total heat (enthalpy) of <u>outdoor air</u> is compared to total heat of <u>return air</u> to decide which is more economical for efficient cooling coil operation.



Typical AHU Damper Sequences

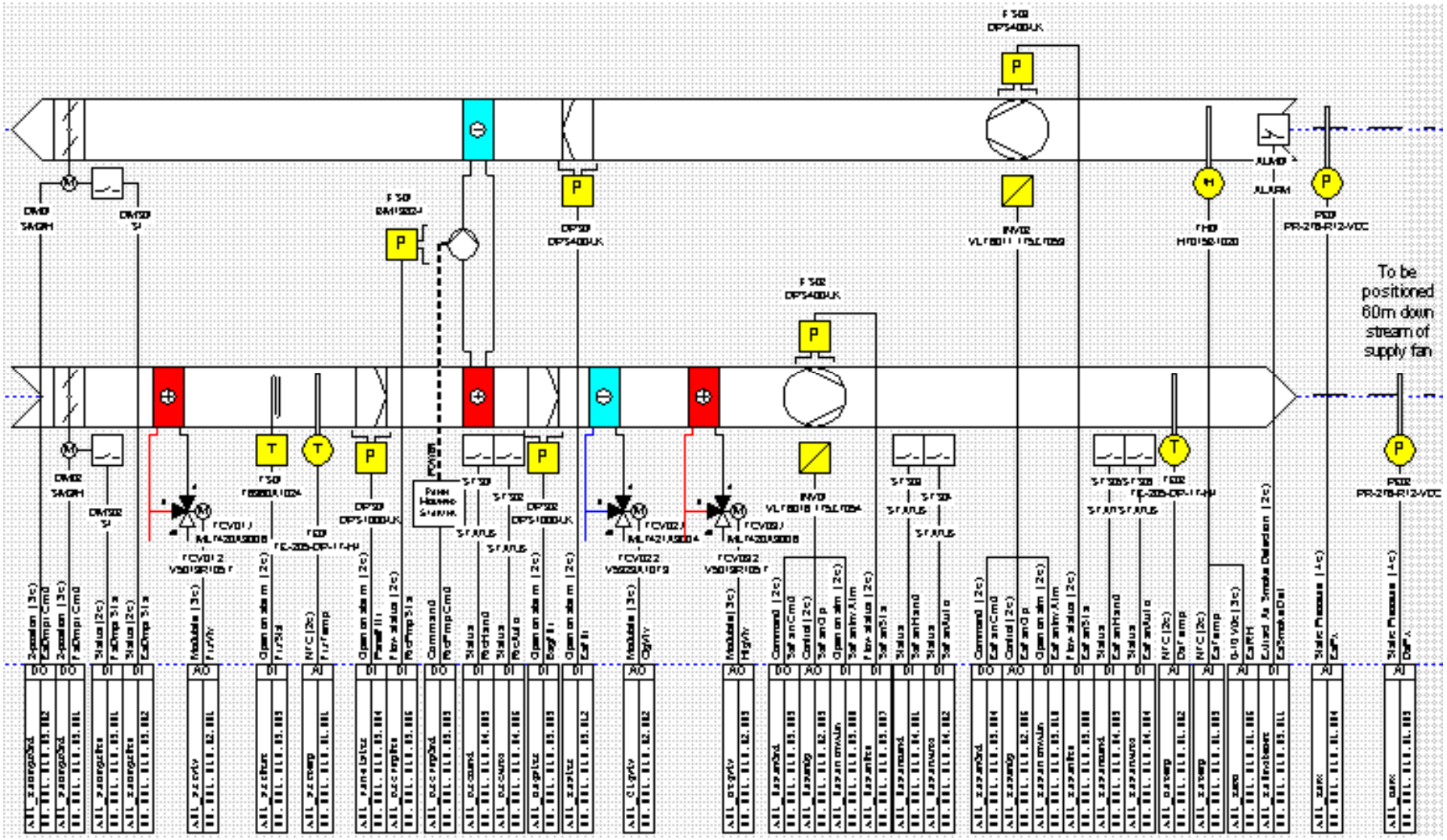
- Example of operation with OA enthalpy lower:
- MA StPt = 55 deg
  - MA temp = 55 deg
  - MA controller out = 50%
- OA humidity = 35%
- OA temp = 60 deg
- RA humidity = 39%
- RA temp = 71 deg
- Outdoor air enthalpy is lower than return air enthalpy, so relay passes MA controller signal.
- Min. Pos. StPt = 25%
- OA damper = 50%



Practical Example

100%Outside Air AHU :

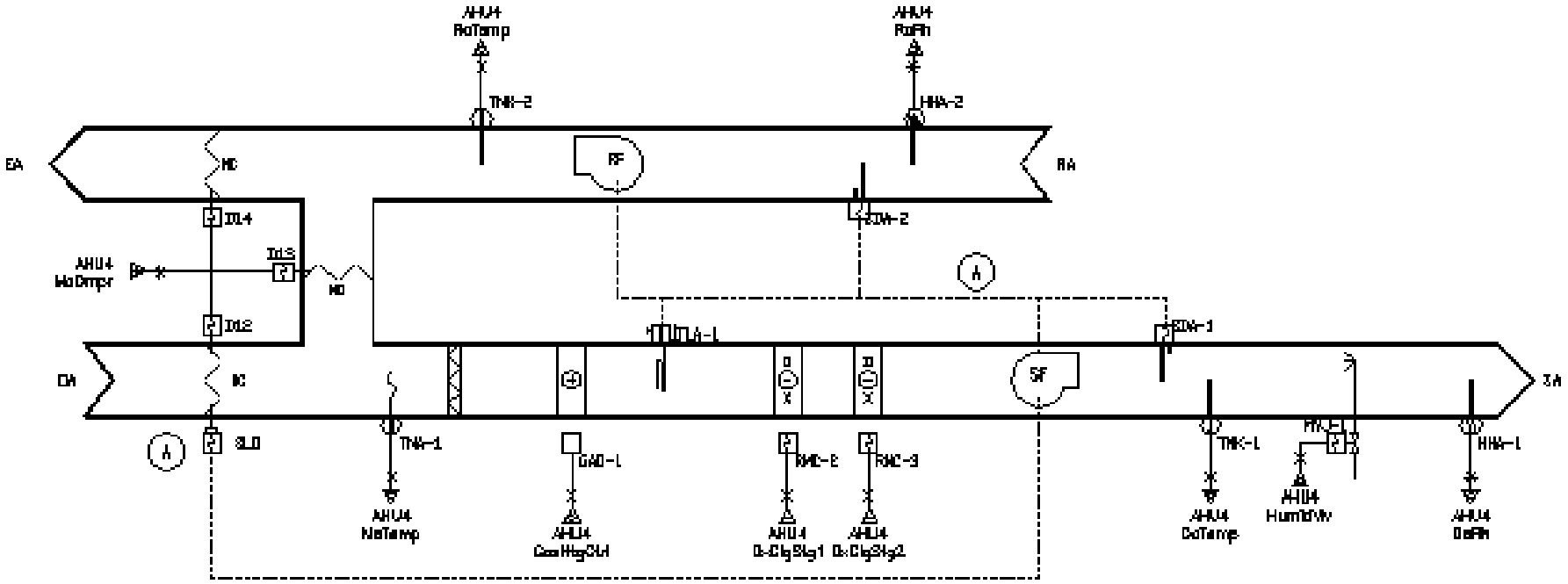
OA AHU Seq



Practical Example

Mixed Air AHU :

Seq of Oper AHU



Plant

Chiller Plant

Chiller Plant

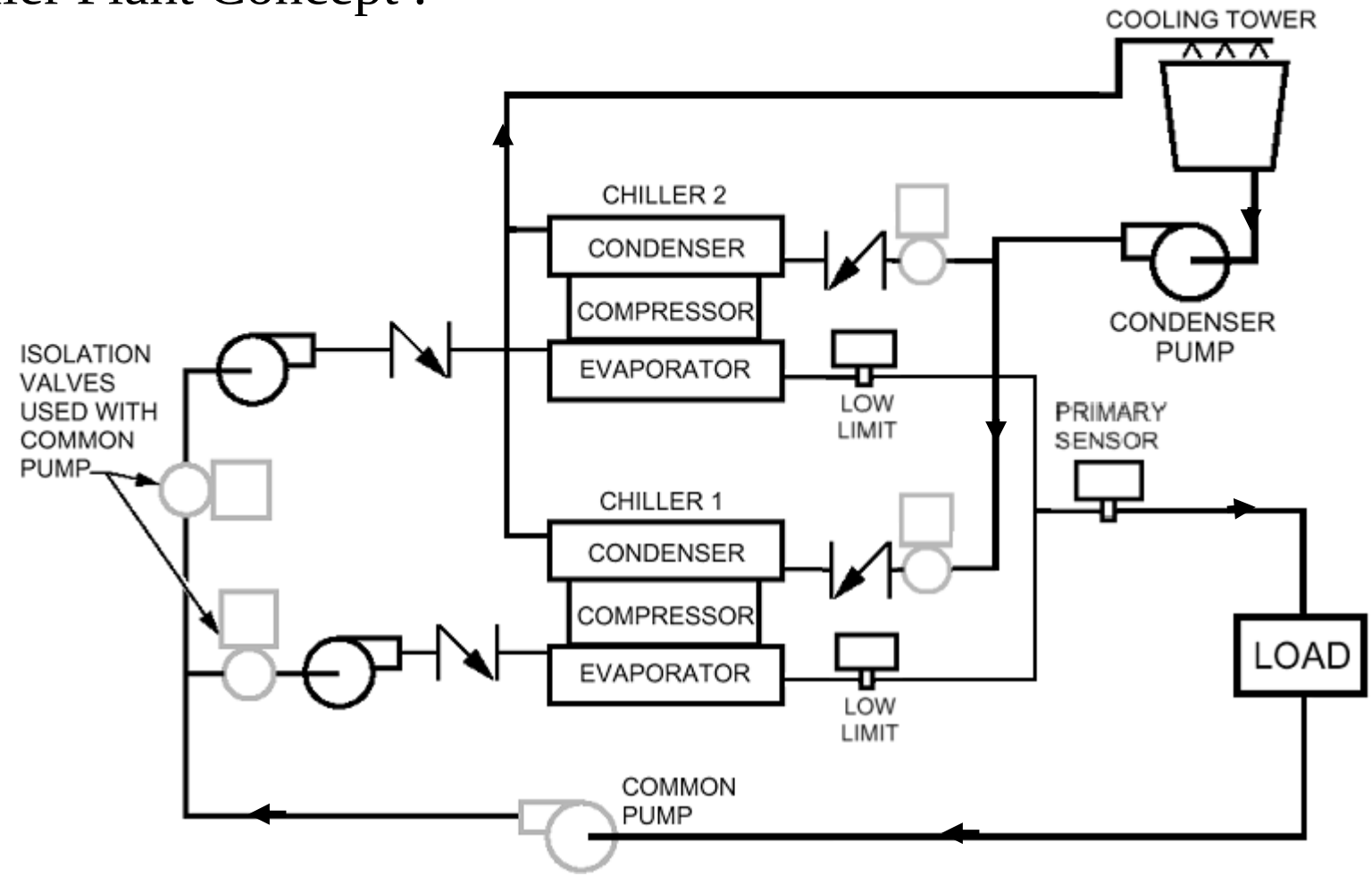
Chiller Plant systems are made up of:

- Chiller/Condenser Unit
- Chilled Water Pumps
- Condenser Water Pumps
- Cooling Towers
- Makeup Water Tank
- A/C Expansion Water Tank

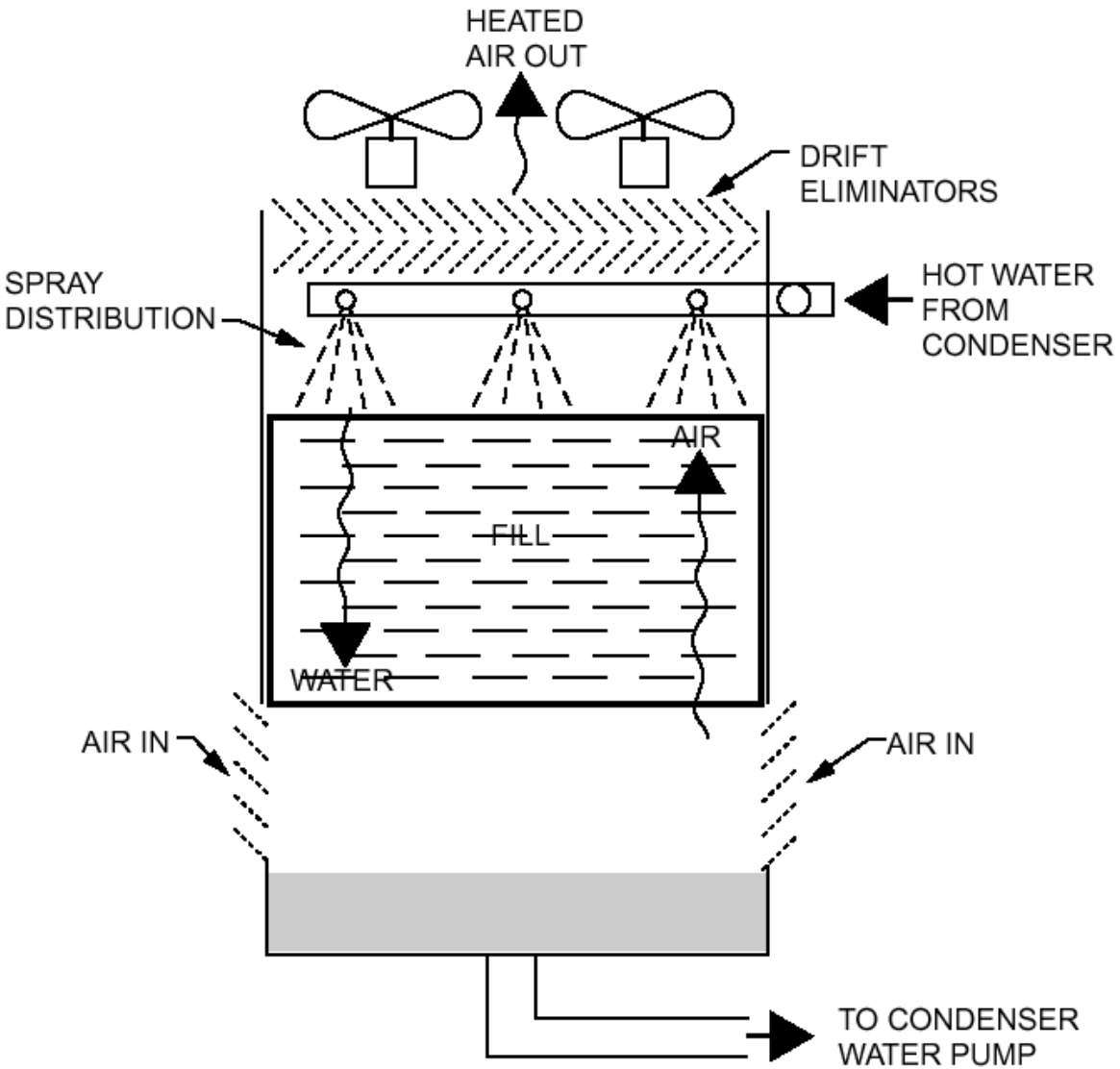
TRANE Chiller

Chiller Plant

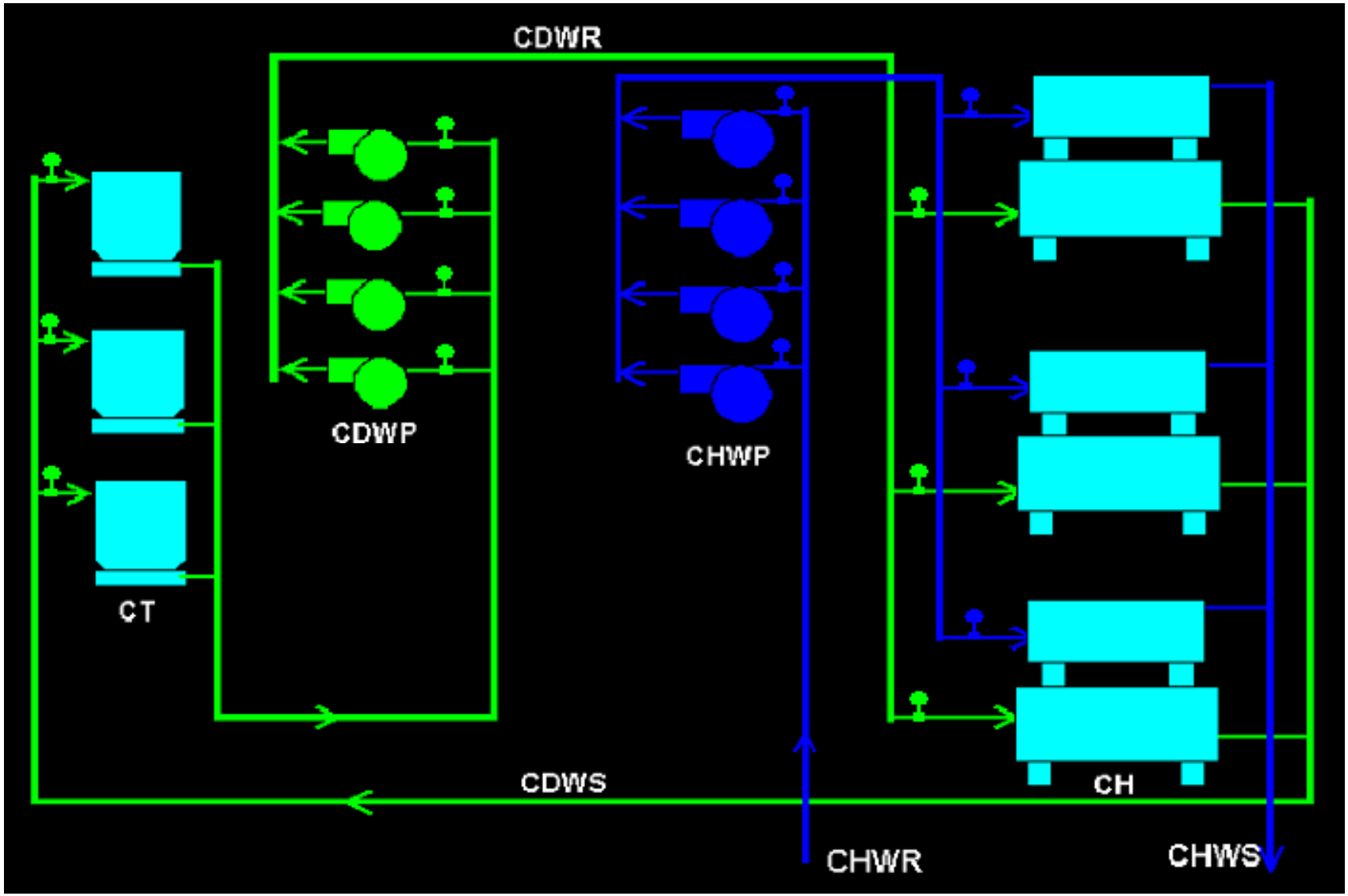
Chiller Plant Concept :



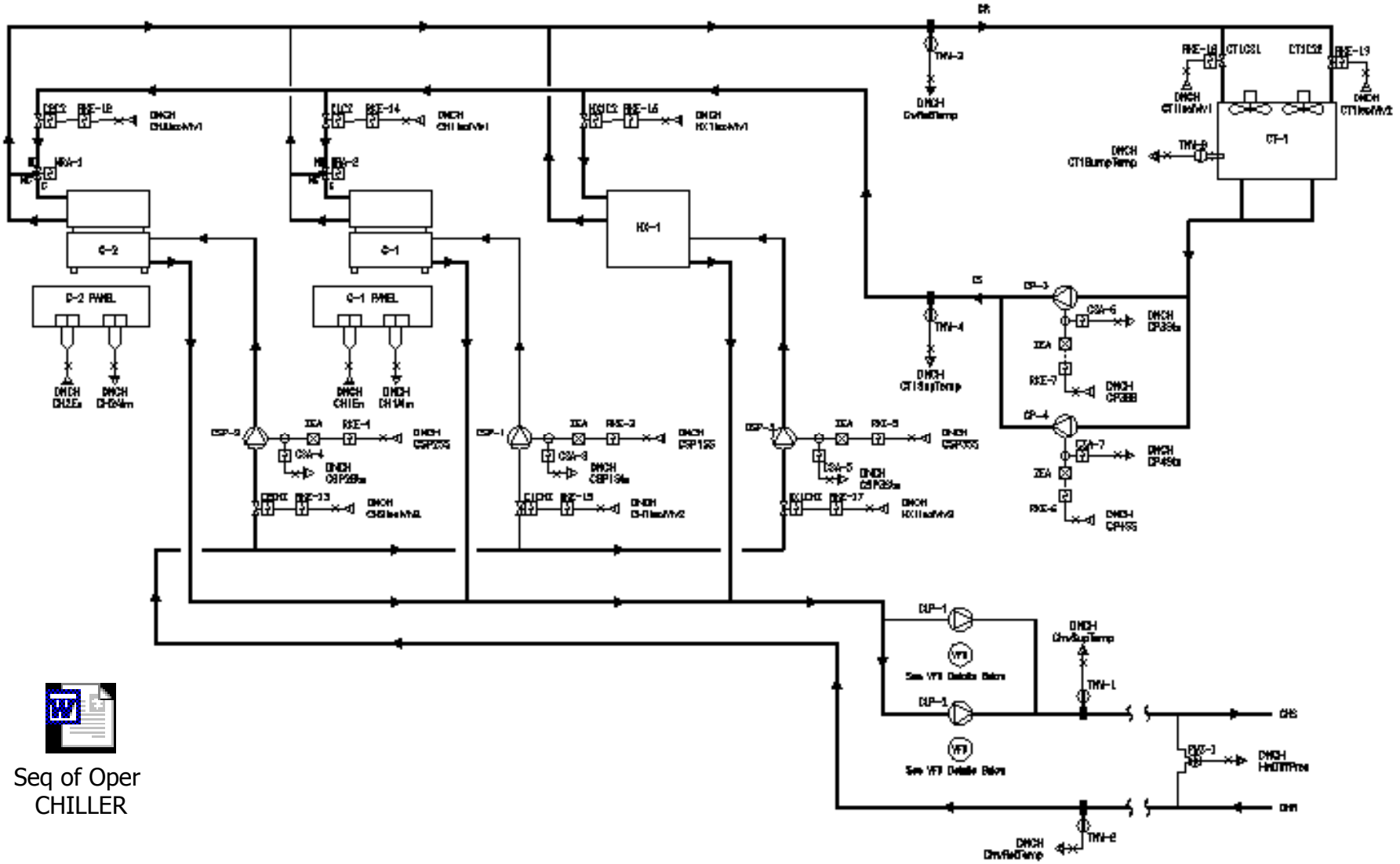
Typical Cooling Tower



Typical Chiller Plant

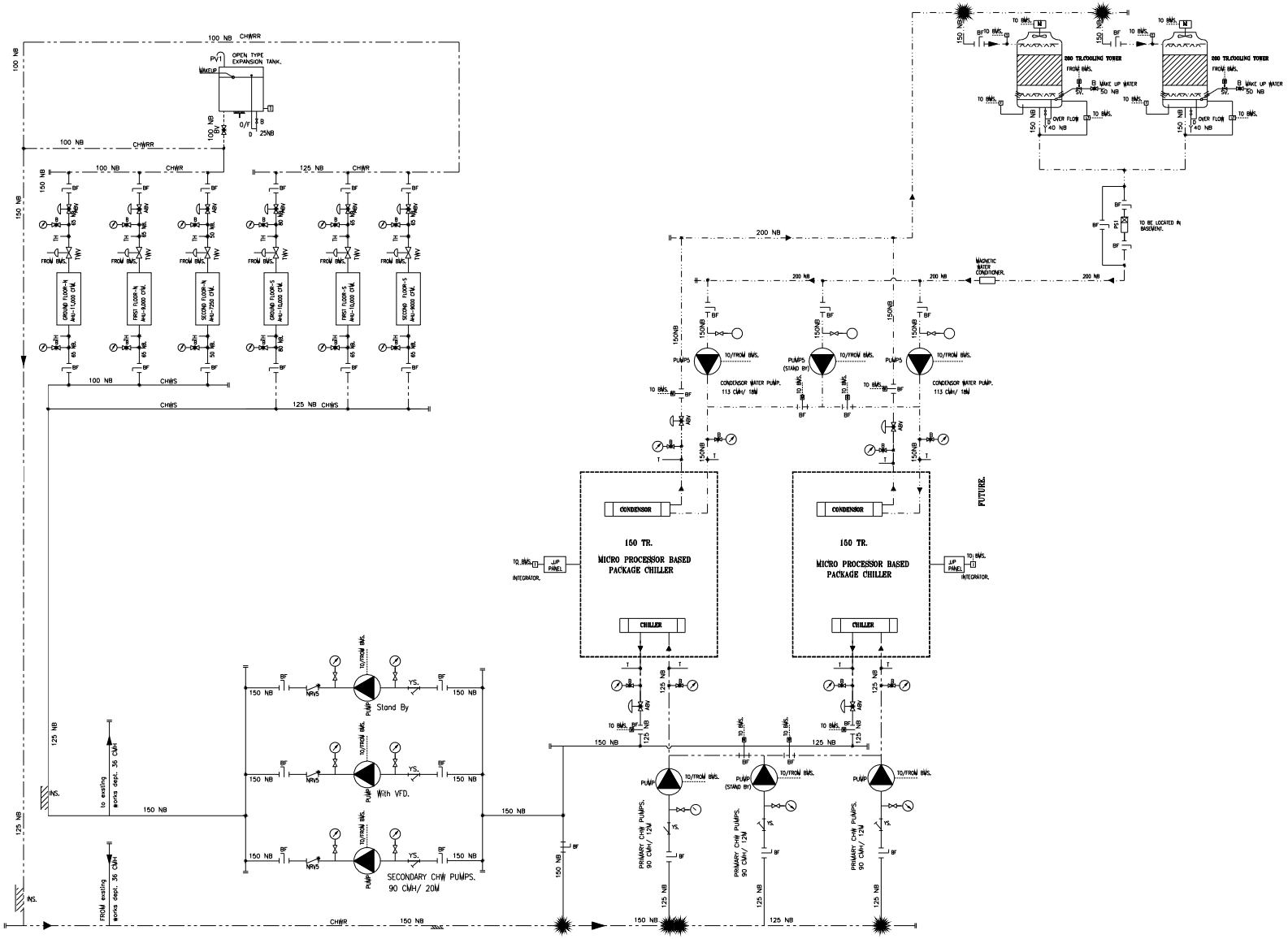


Example Chiller Plant

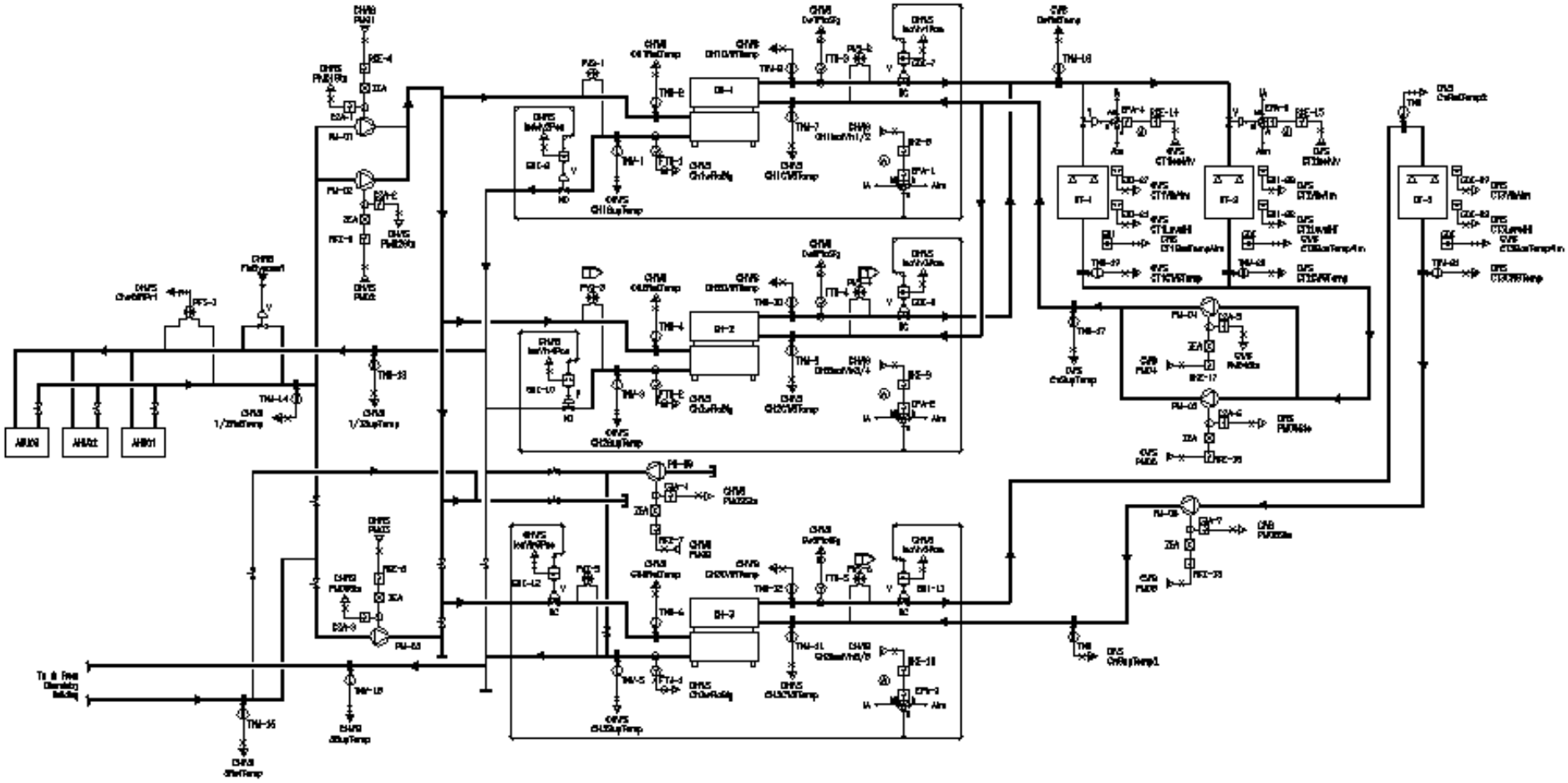


Seq of Oper
CHILLER

Example Chiller Plant (THL New Building)



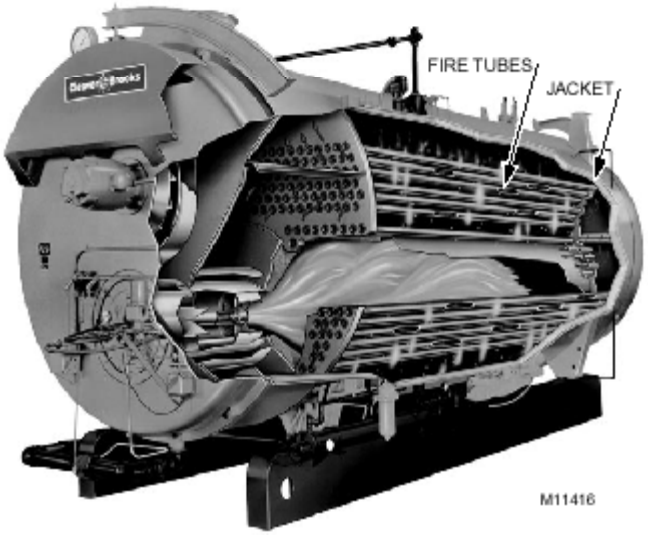
Example Chiller Plant



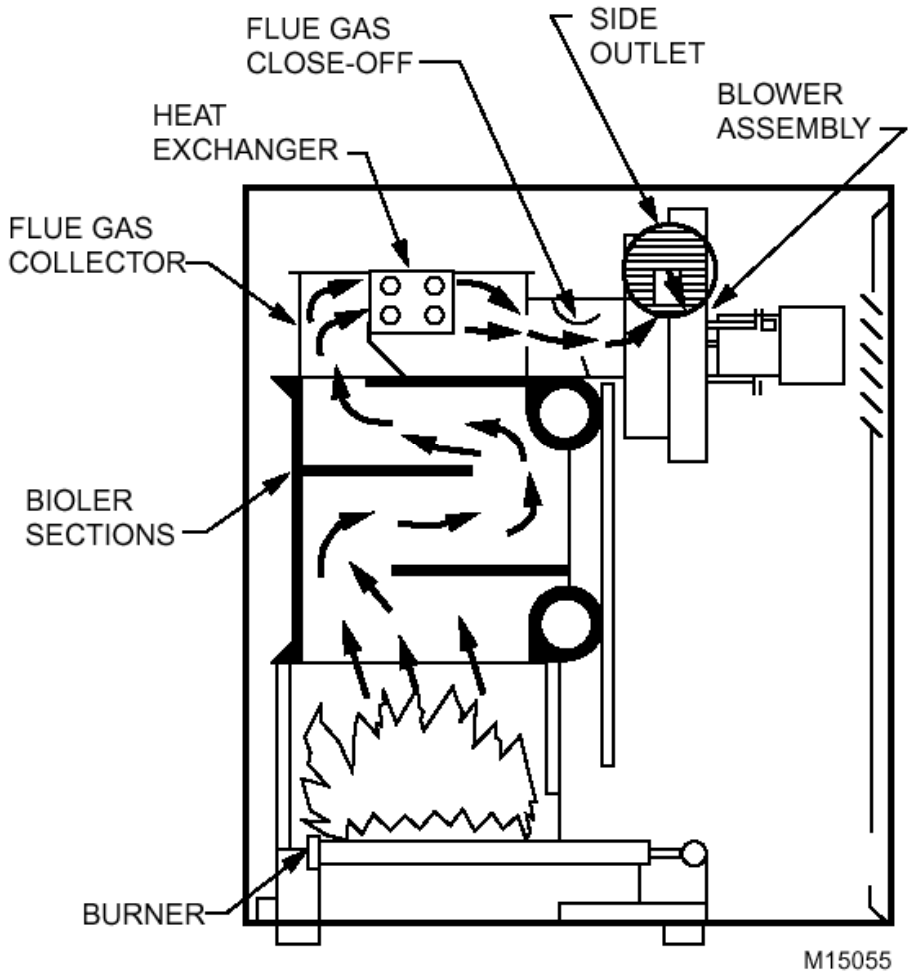
Boiler Plant

Boiler Plant systems are made up of:

- Boiler Units
- Primary Pumps
- Secondary Pumps

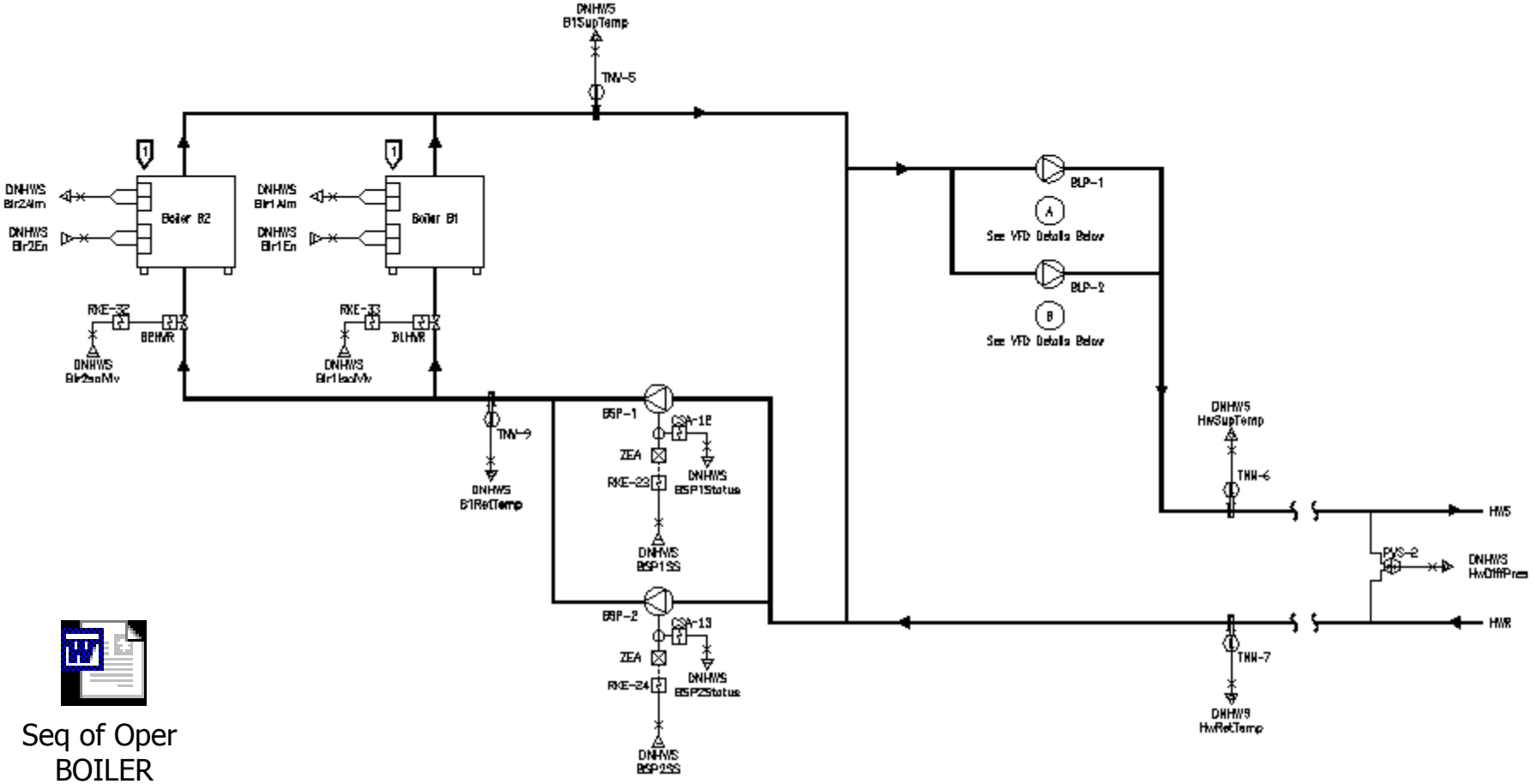


Typical Firetube Boiler



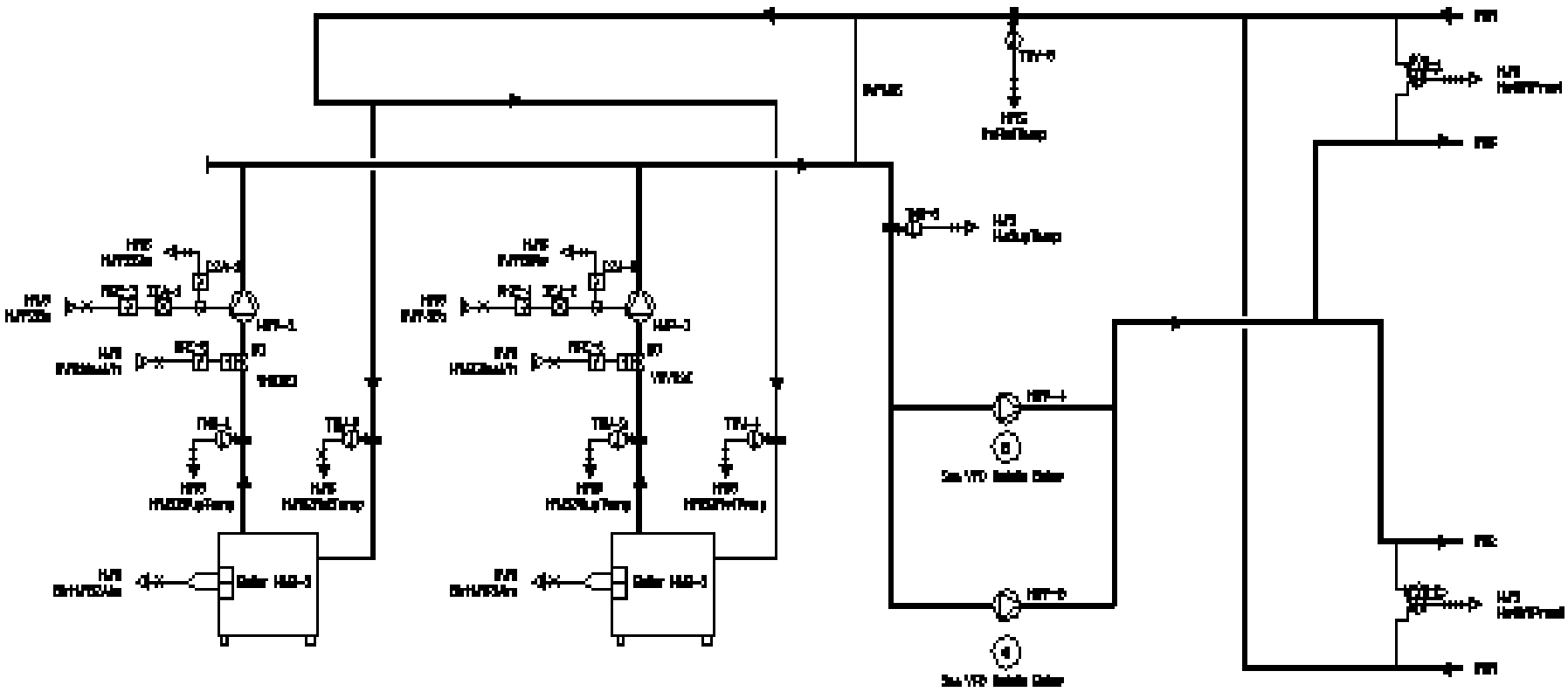
Boiler Plant

Boiler Plant Example

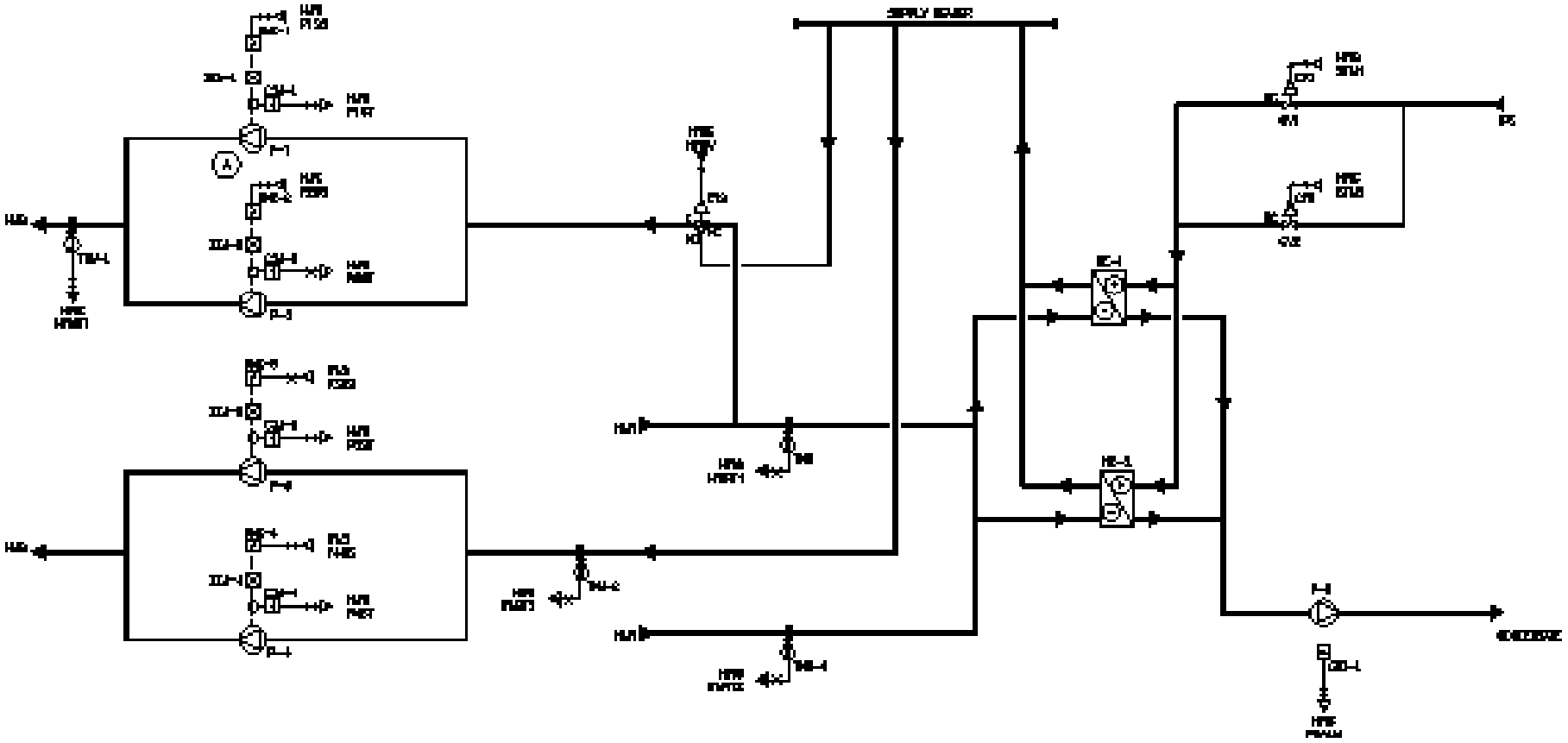


Seq of Oper
BOILER

Boiler Plant Example



Boiler Plant Example



end