

CAE 464/517 HVAC Systems Design

Spring 2021

January 21, 2021

Intro to the course and HVAC drawings

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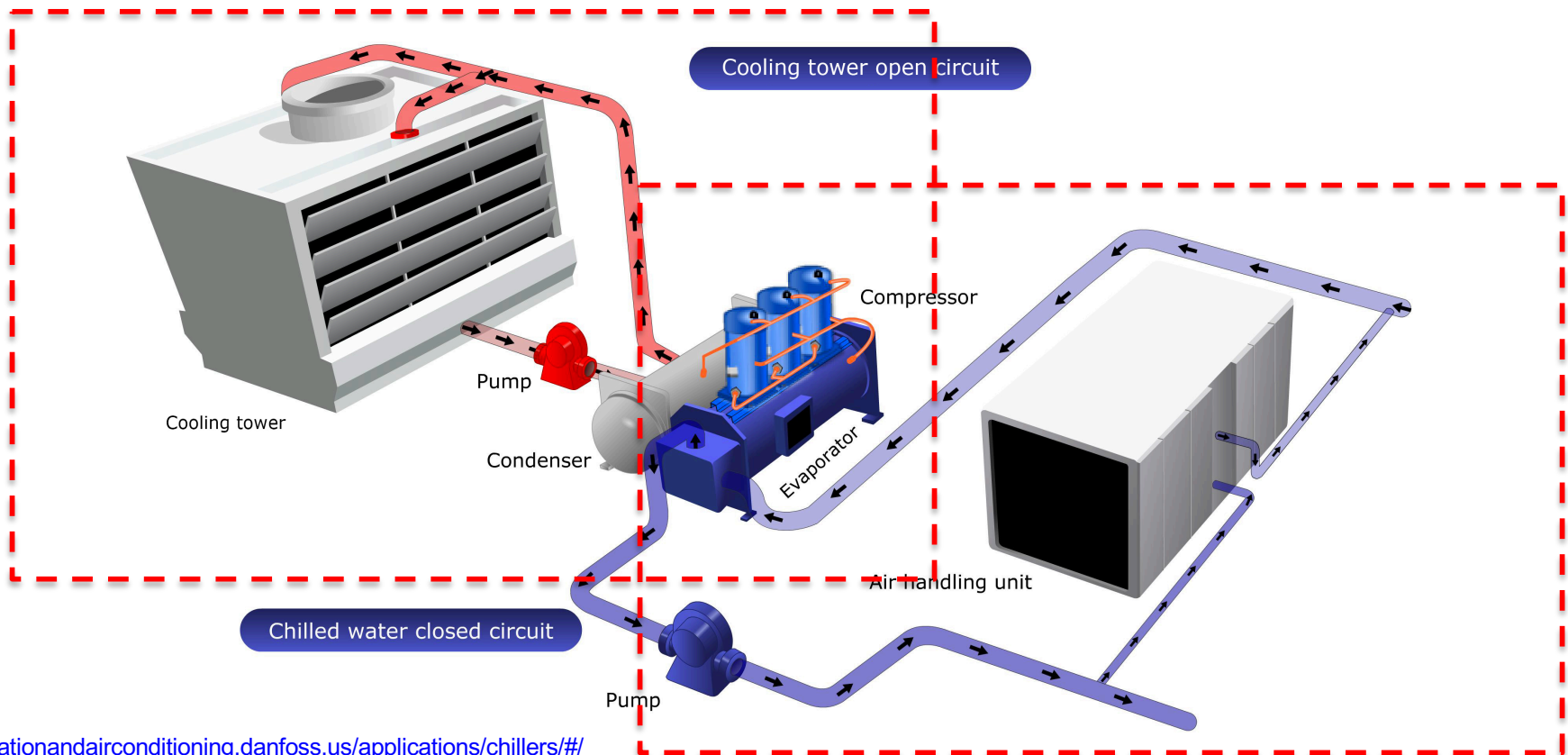
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RECAP

Recap

- HVAC system may include main parts:
 - Primary systems or central plant
 - Distribution system
 - Terminal devices
 - Controls



Recap

- Secondary system(s) may have different working fluids:
 - Hydronic systems (Water or steam)
 - Heat transfer to space by natural or forced convection
 - Only sensible load is met this way
 - Air systems (Air)
 - Both sensible and latent loads are met by a single supply air stream to each space
 - Deliver the required air ventilation
 - Require large volume of air

Recap

- Secondary systems entail:
 - ❑ Distribution system:
 - Ducts or pipes to carry working fluids
 - ❑ Equipment to compensate for pressure drop and move the working fluids:
 - Fans or pumps
 - ❑ Heat exchanger devices to transfer cool or heat from the working fluid to air:
 - Cooling or heating coils
 - ❑ Terminal devices to control, distribute, and deliver cooled or heated air to different zones:
 - Radiators, fan coils, room diffusers
 - ❑ Control devices to modulate the flow:
 - Temperature sensors, valves, dampers, thermostats

BUILDING HVAC SYSTEMS

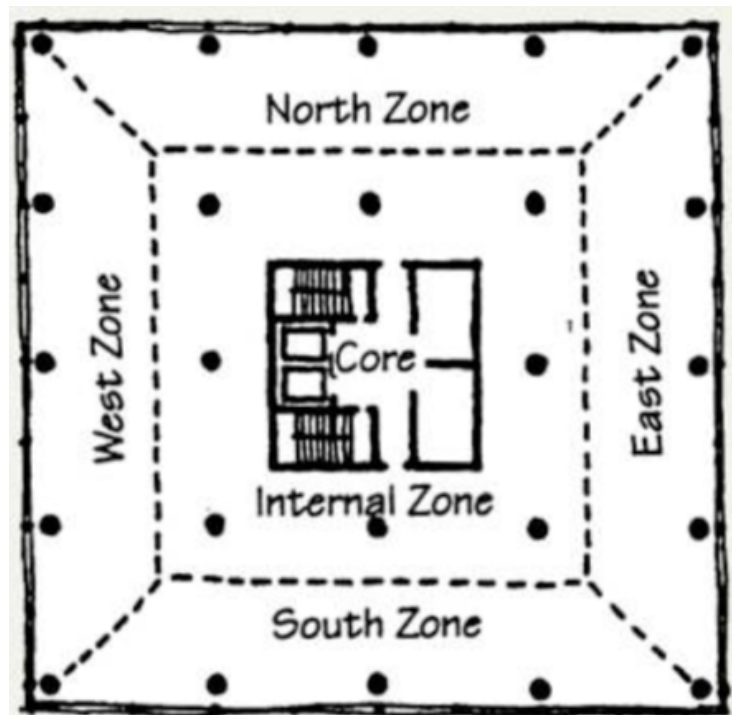
Building HVAC Systems

- Heating equipment, energy, distribution, and cycle options:
 - ❑ **Equipment:** Boiler, furnace, heat pump, electric resistance
 - ❑ **Energy:** Natural gas, oil, steam, electrical, renewable, waste heat
 - ❑ **Distribution:** Air, steam, water
 - ❑ **Cycle:** Vapor compression, combustion, renewable

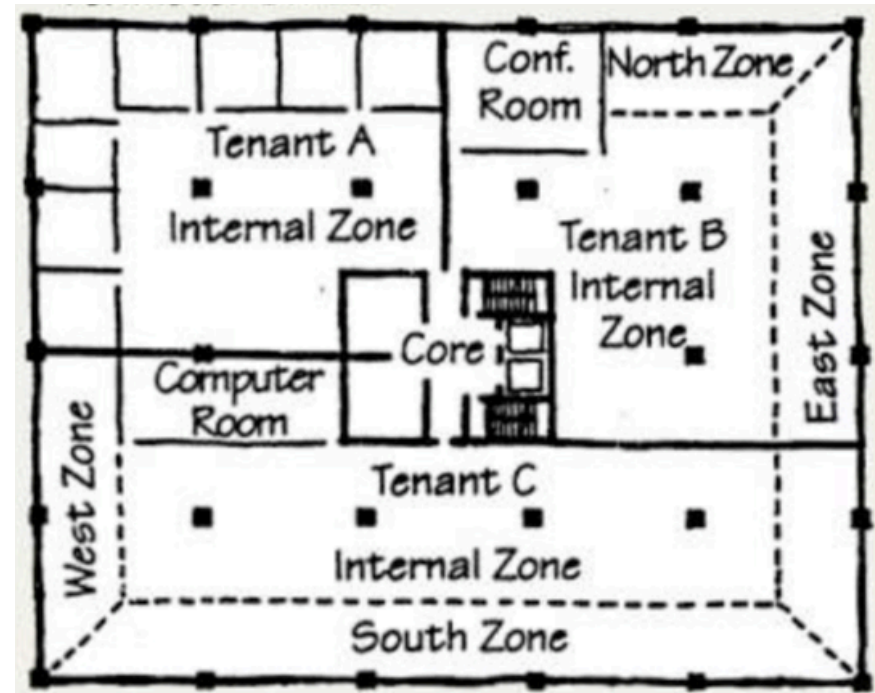
- Cooling equipment, energy, distribution, and cycle options:
 - ❑ **Equipment:** Air conditioner, chiller, heat pump
 - ❑ **Energy:** Electrical, natural gas, steam, waste heat, renewable
 - ❑ **Distribution:** Chilled water, air
 - ❑ **Cycle:** Vapor compression, absorption

Building HVAC Systems

- Thermal zone or zone:
 - ❑ Is a space or collection of spaces having similar space-conditioning requirements
 - ❑ Has the same heating and cooling setpoint



Based on orientation and floor



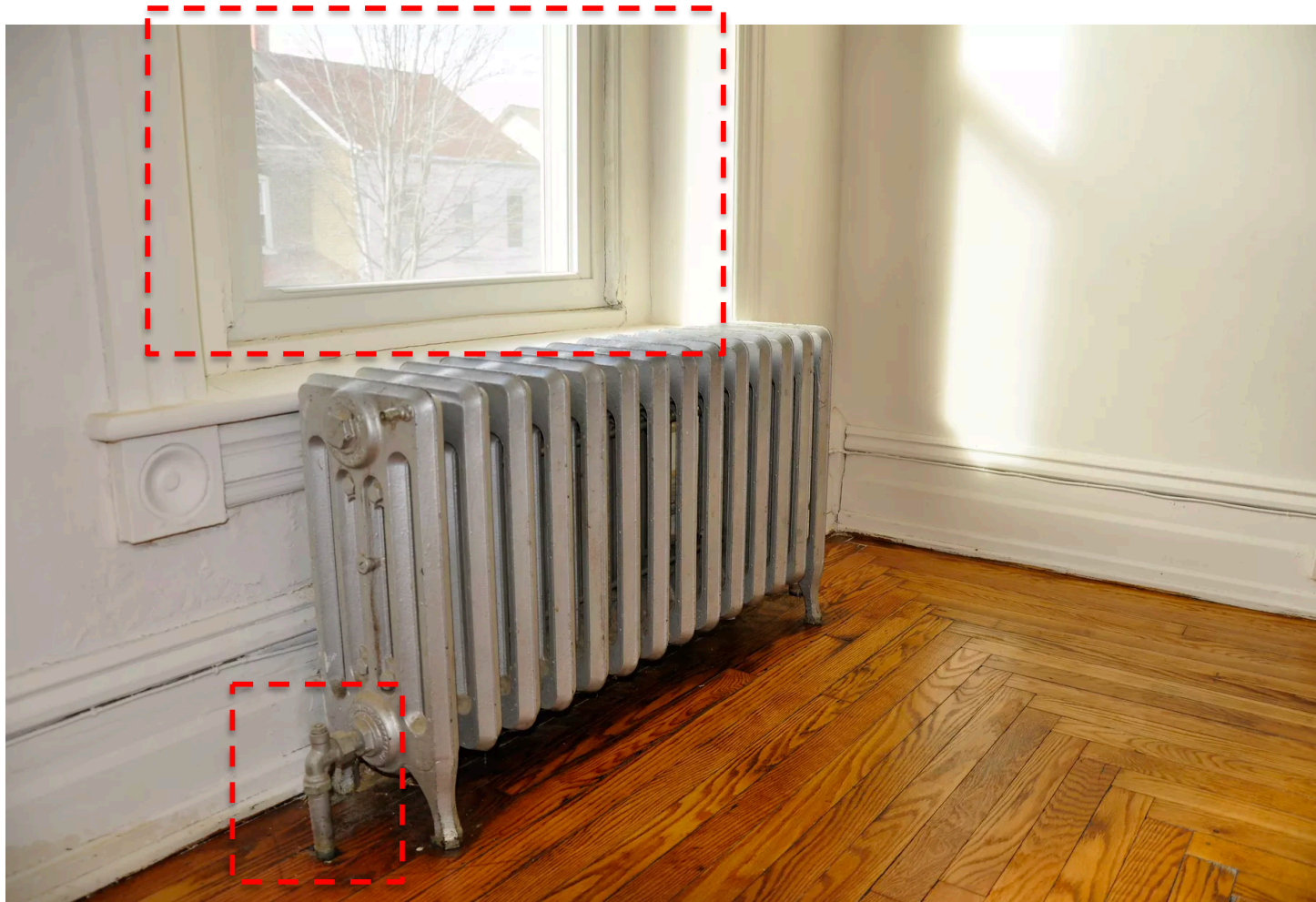
Based on spaces

Building HVAC Systems

- Common ventilation types:
 - ❑ Constant Air Volume (CAV):
 - Hold the system airflow rate constant
 - Let the space thermostat modulate the supply air temperature
 - ❑ Variable Air Volume (VAV):
 - Modulate supply airflow rate
 - Hold the supply air inlet temperature constant
 - ❑ Dedicated Outdoor Air System (DOAS):
 - Consist of two parallel systems
 - Deliver outdoor to handle both latent and sensible loads
 - Include a parallel system to handle mostly sensible loads

Building HVAC Systems

- Can we have a system with no ventilation type?



Why do you think most of the radiators are located under the windows?

Building HVAC Systems

- Strategies to understand the topics in this class is to identify:
 - System types:
 - Air distribution systems
 - Hydronic systems
 - Refrigeration systems
 - Energy sources
 - Primary and secondary
 - Ventilation types

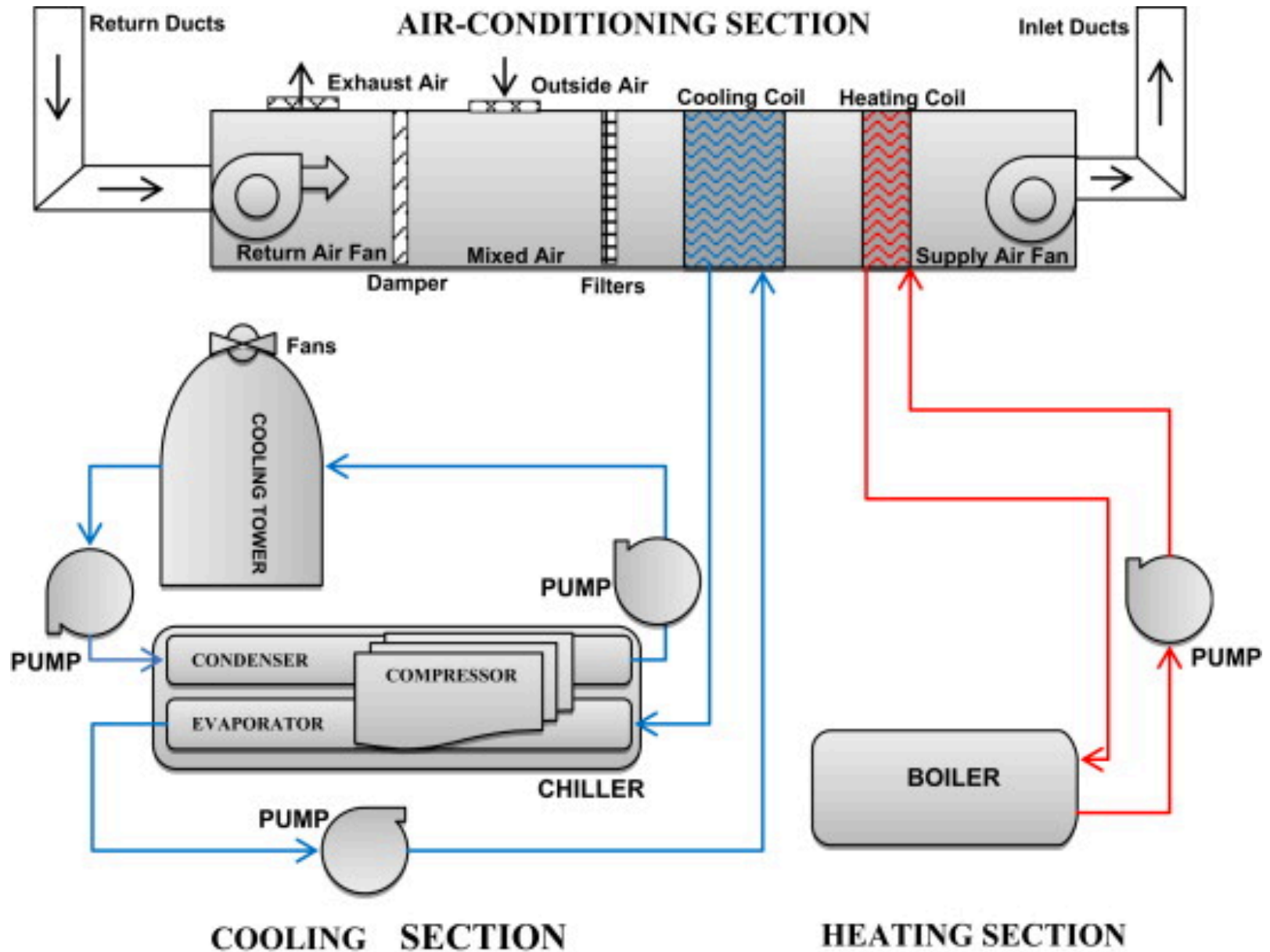
Building HVAC Systems

- HVAC systems categories in terms of their distribution and integration of components are categorized as:
 - ❑ Unitary
 - Local systems
 - Each room has an HVAC system
 - ❑ Centralized
 - Central systems (all HVAC equipment in one room)
 - Semi-central systems
 - ❑ District
 - Central systems (all HVAC equipment in one room)
 - Semi-central systems

Building HVAC Systems

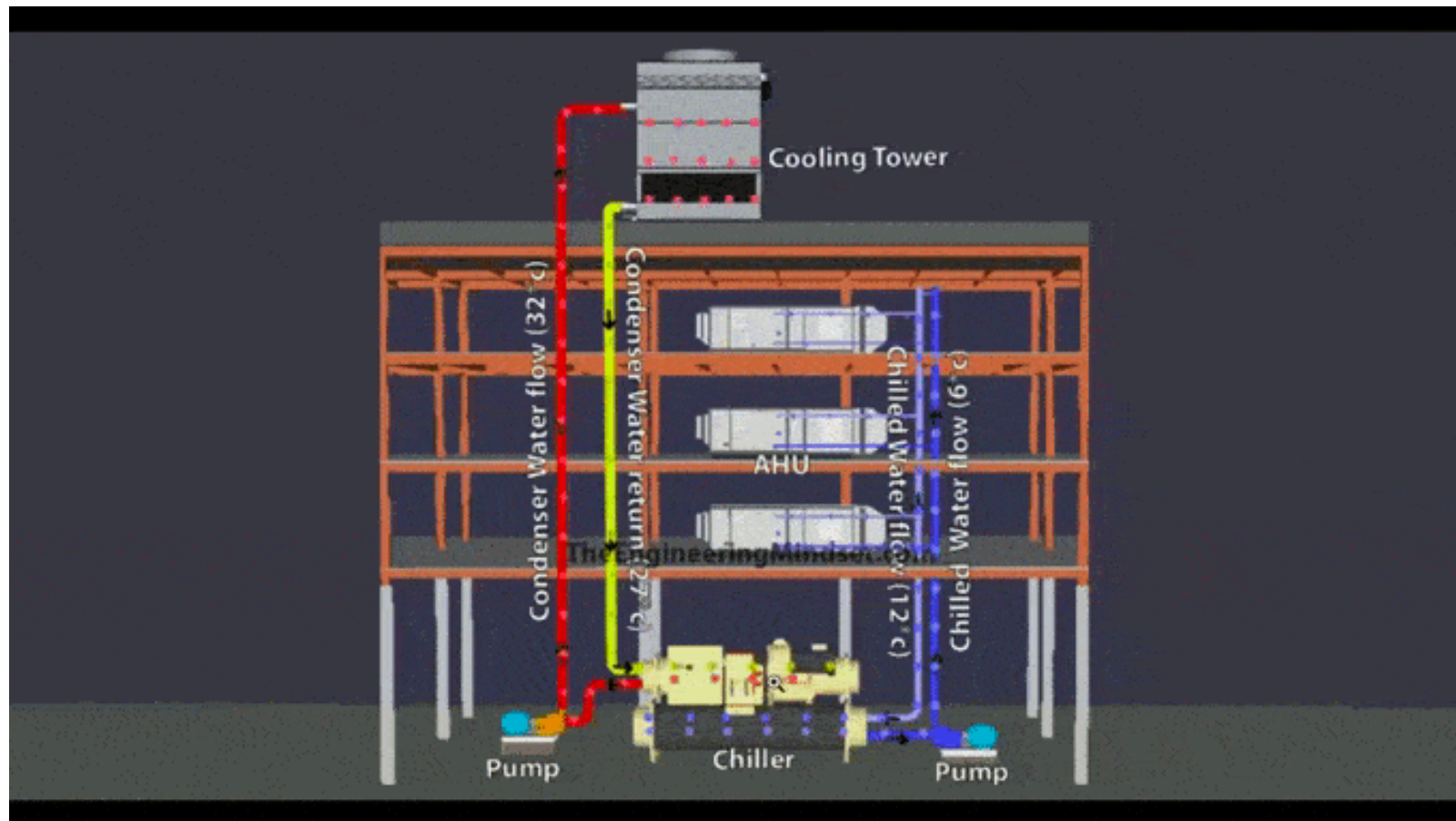
- How do we select HVAC systems?
 - Performance requirements (loads, process)
 - Capacity requirements (building types, loads)
 - Spatial requirements (building types)
 - First costs (location, size of HVAC, investment)
 - Operating costs
 - Reliability
 - Flexibility
 - Maintainability

Building HVAC Systems



Building HVAC Systems

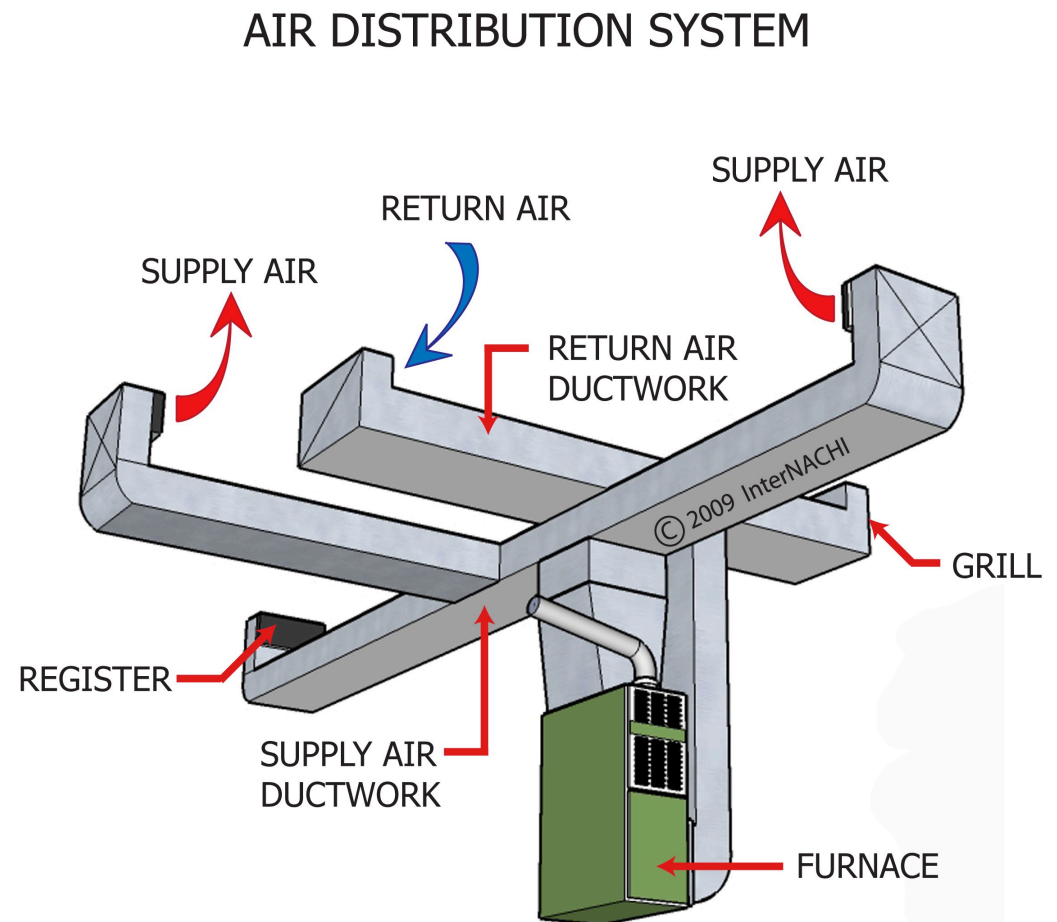
- How many loops do you see here?



INTRODUCTION TO AIR DISTRIBUTION SYSTEMS

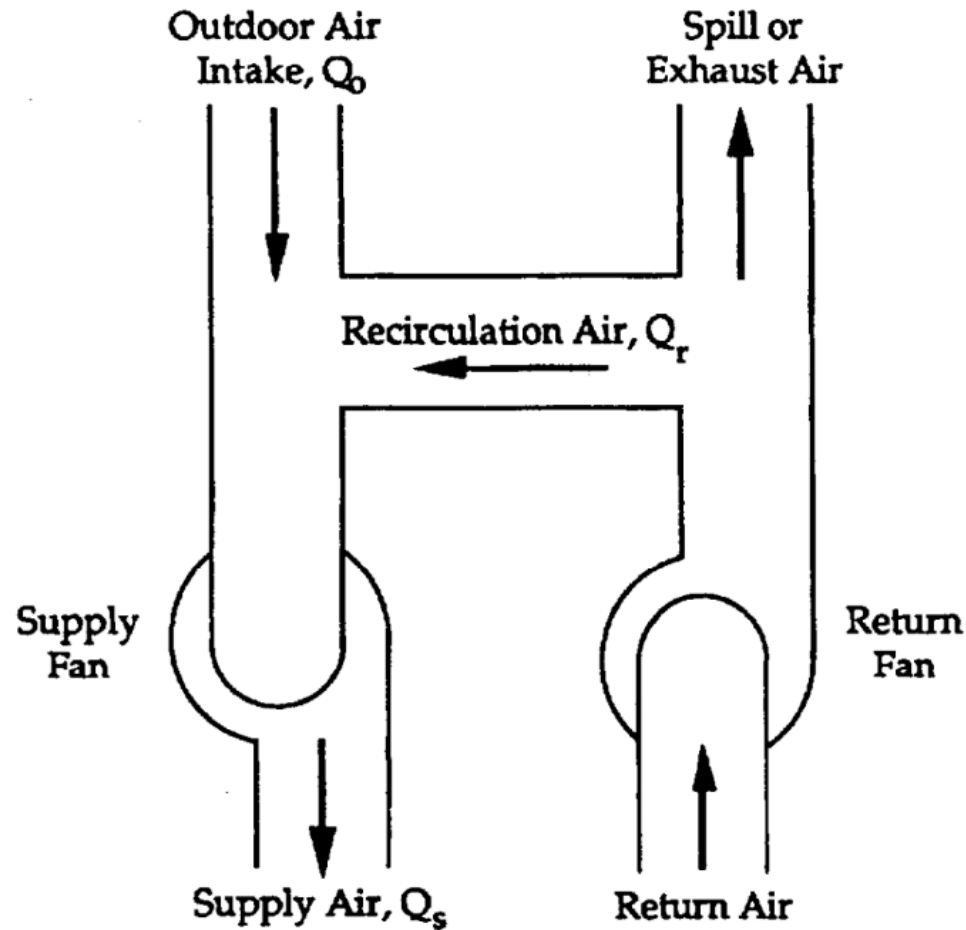
Air Distribution Systems

- Air distribution components:
 - ❑ Air handlers (known as AHU)
 - ❑ Air distribution devices
 - ❑ Ductwork
 - ❑ Heating and cooling coils
 - ❑ Dampers
 - ❑ Fans
 - ❑ Controls



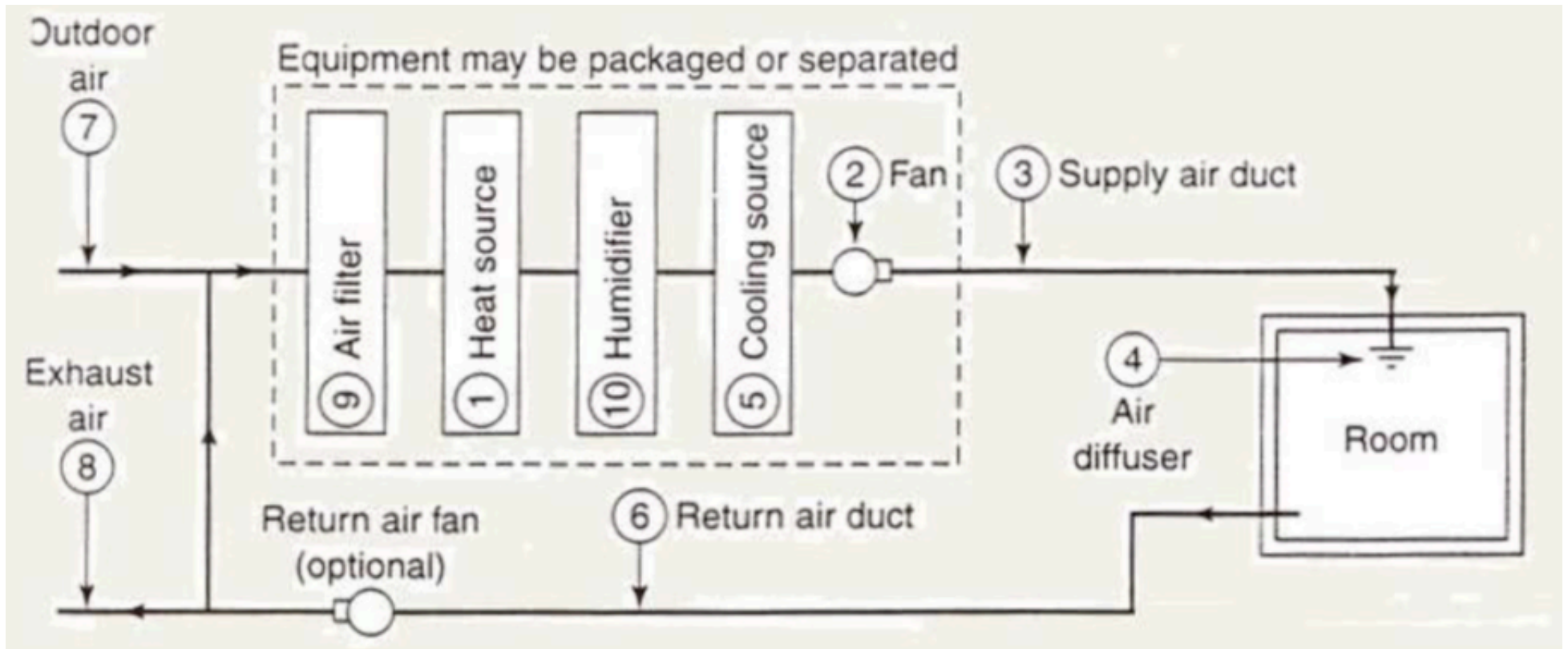
Air Distribution Systems

- An AHU system may include:



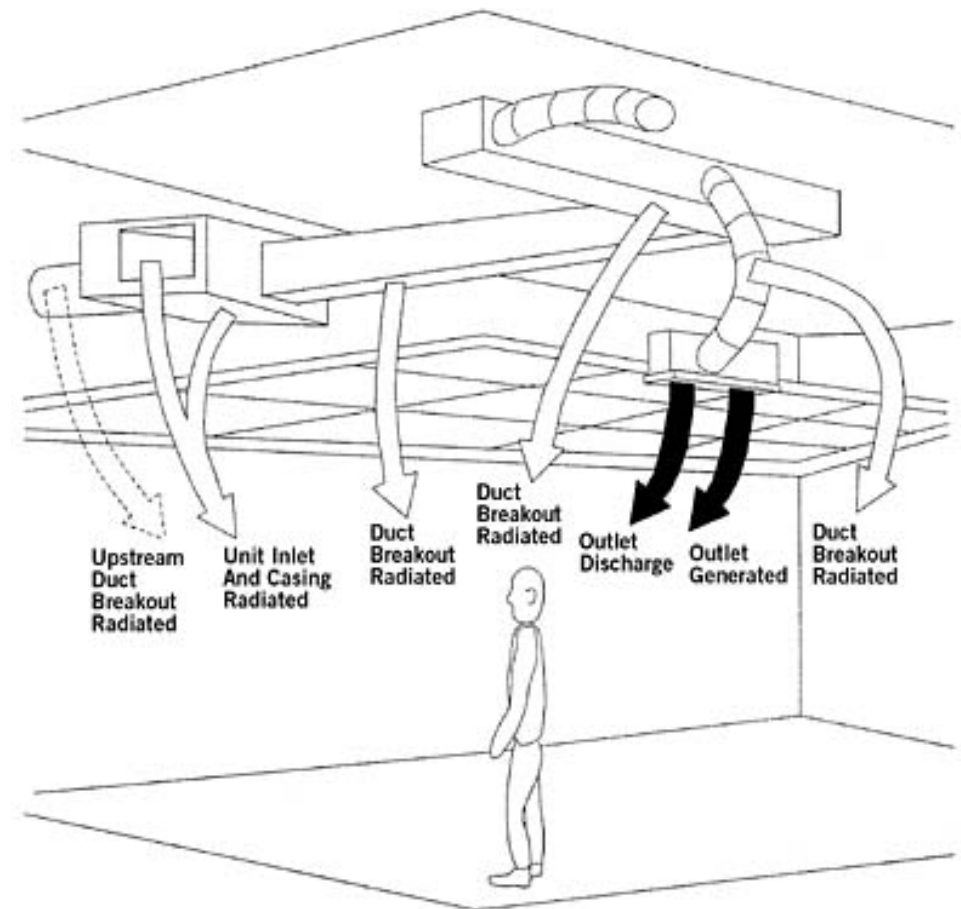
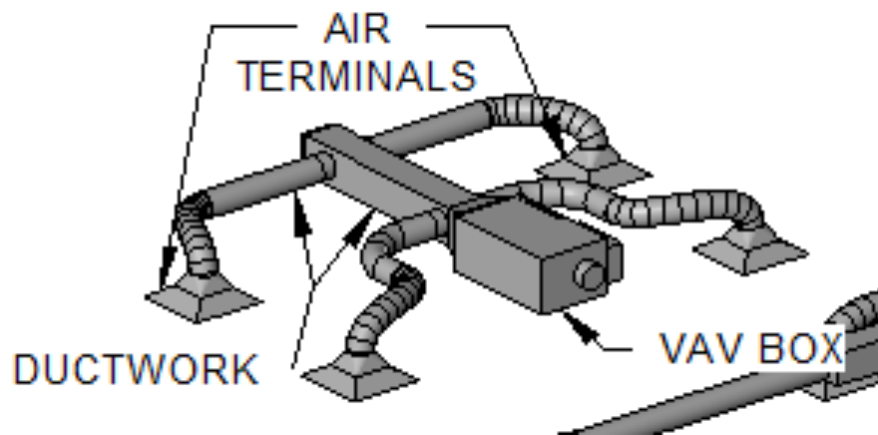
Air Distribution Systems

- All air systems:



Air Distribution Systems

- Energy is transferred to the room air by
 - ❑ Terminal devices such as radiators and fan units
 - ❑ Air stream that needs to supply via terminal boxes or room diffusers

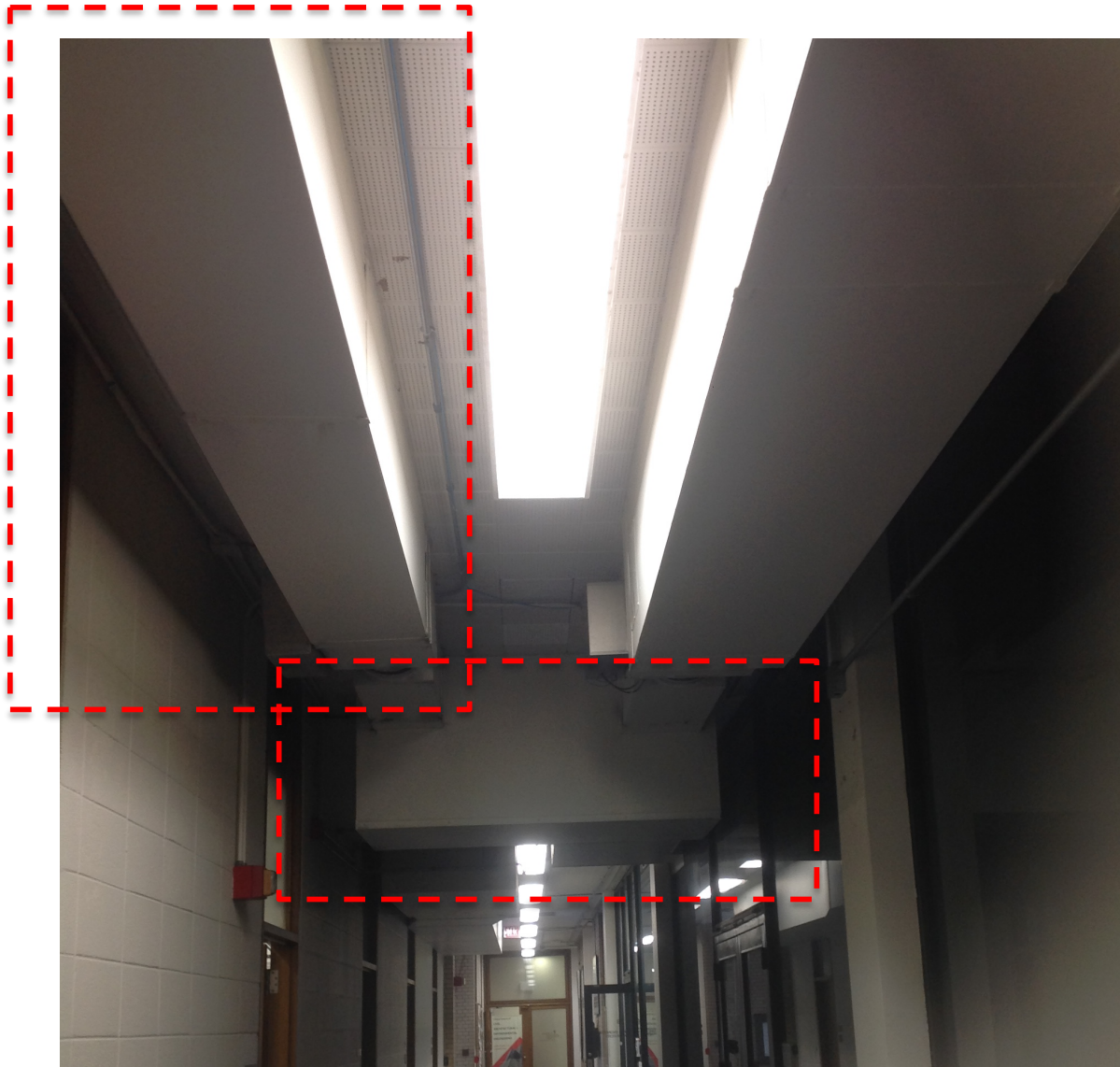


Air Distribution Systems

- Terminal boxes are located in:
 - ❑ Space above the suspended ceiling in a zone
 - ❑ Air travels from them through ductwork (flexible or rigid) to diffusers
 - ❑ There are many variations in the terminal boxes
 - ❑ The spaces above the suspended ceiling can be as a return air plenum
 - ❑ Some cases such as laboratories, there are return grills connected directly to the return air ducted named as ducted return
 - ❑ Installation of the grills need design, e.g. heat sources

Air-Distribution Systems

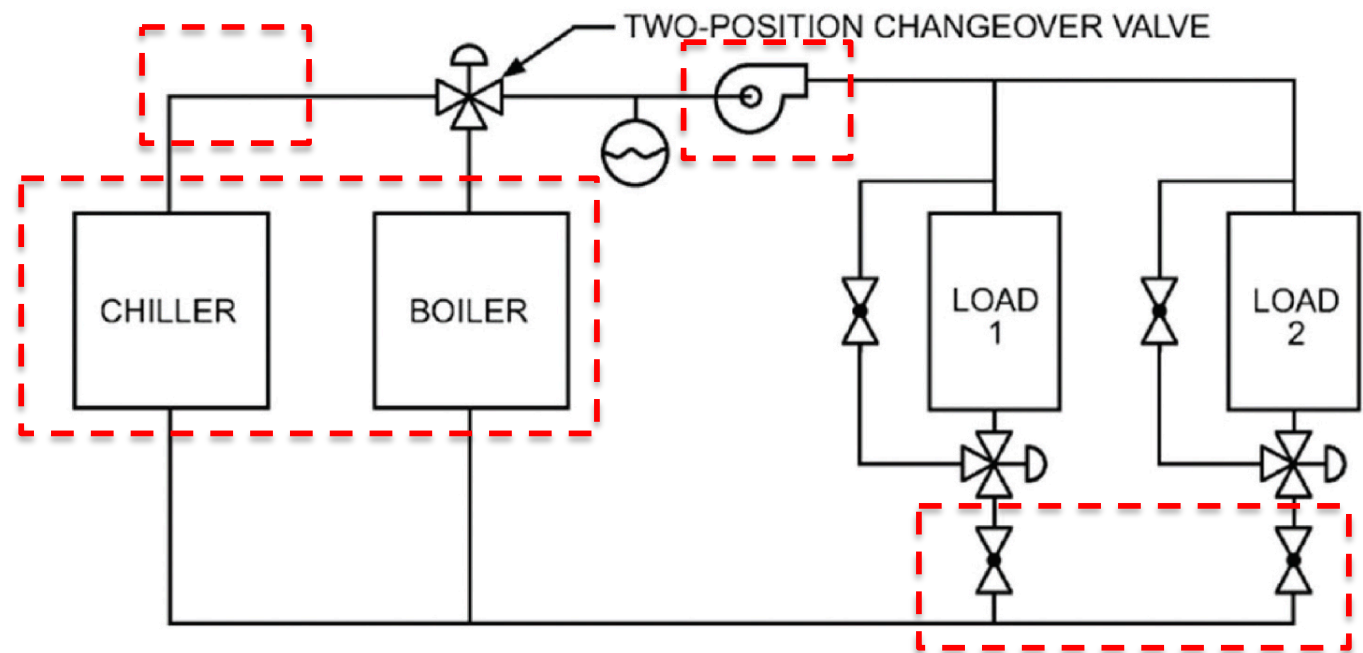
- Do we use this system at IIT?



INTRODUCTION TO AIR HYDRONIC SYSTEMS

Hydronic Systems

- **Hydronics** refers to systems focused on heating or cooling with water:
- Components of a steam or chiller water systems are:
 - Boiler or chiller
 - Piping
 - Valves
 - Pumps
 - Controls



Hydronic Systems

- Do we use this system at IIT?

Heating Plant



Ludwig Mies van der Rohe

Frank J. Kornacker; Alschuler & Sincere, associated architects; Sargent and Lundy, mechanical engineers

1945-50 (addition 1964)

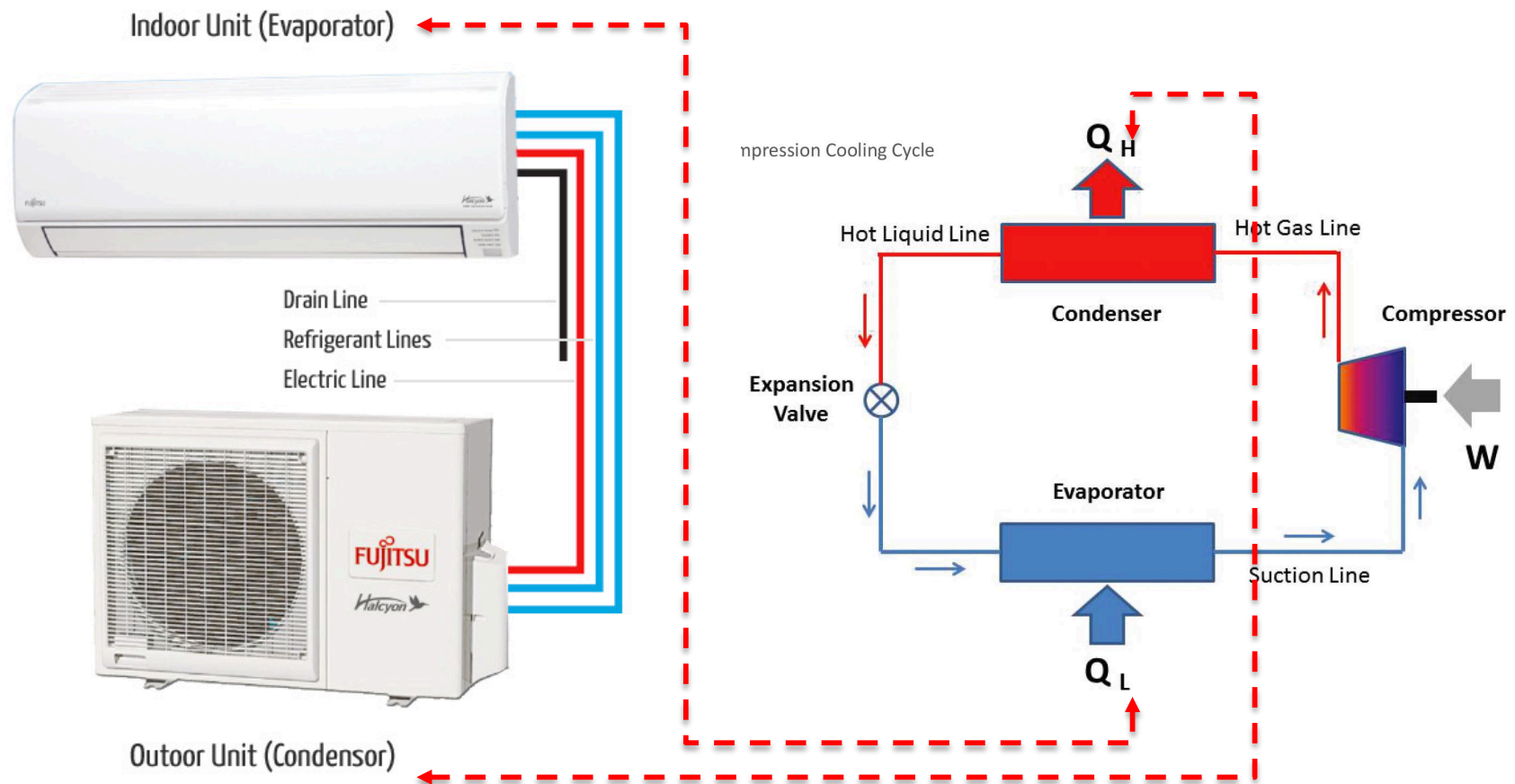
3430 South Federal Street

<http://buildinghistory.iit.edu/buildings/plant>

INTRODUCTION TO REFRIGERATION SYSTEMS

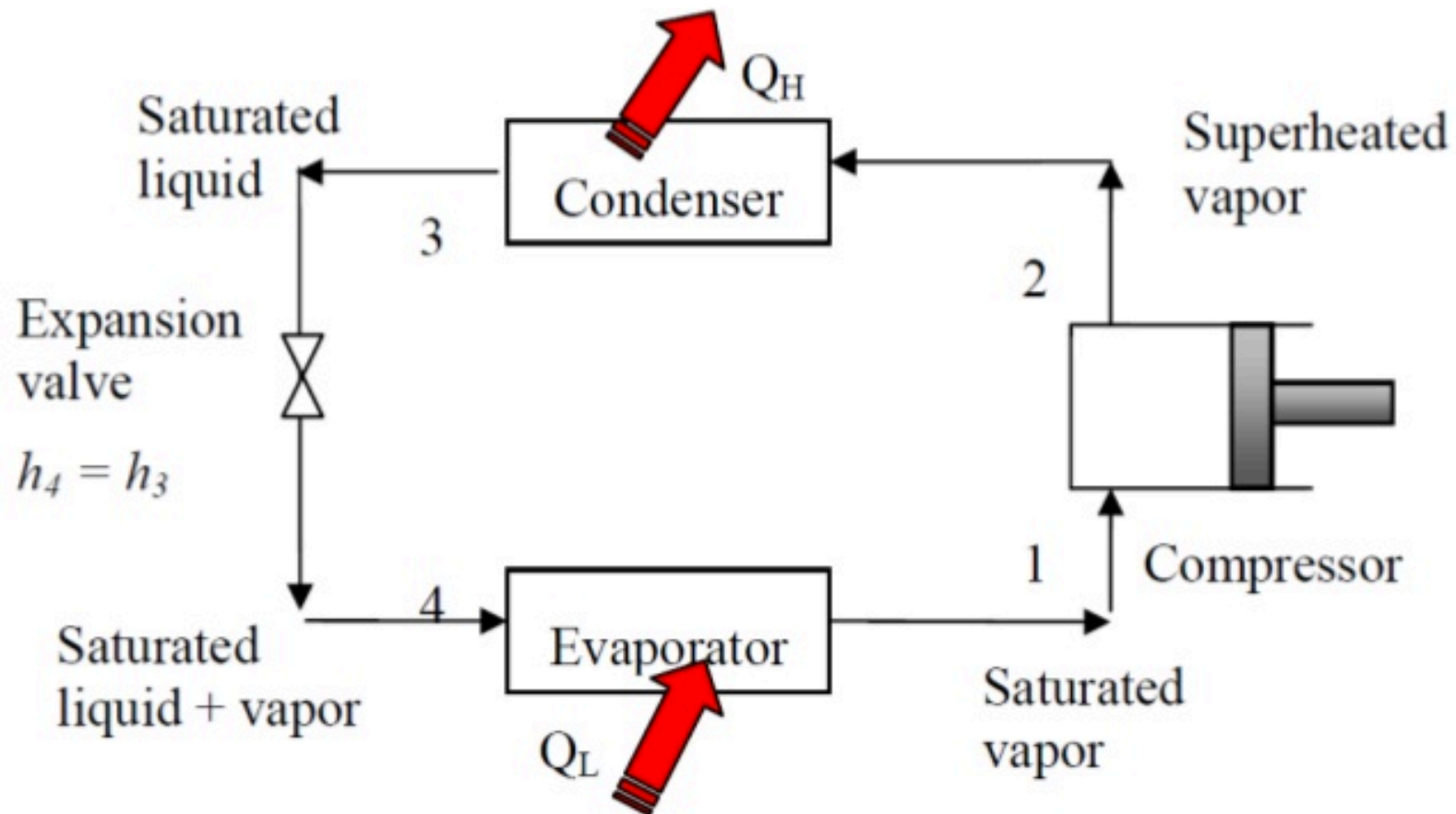
Refrigeration Systems

- **Refrigeration** refers to the process of removing heat from a low-temperature reservoir and transferring it to a high-temperature reservoir



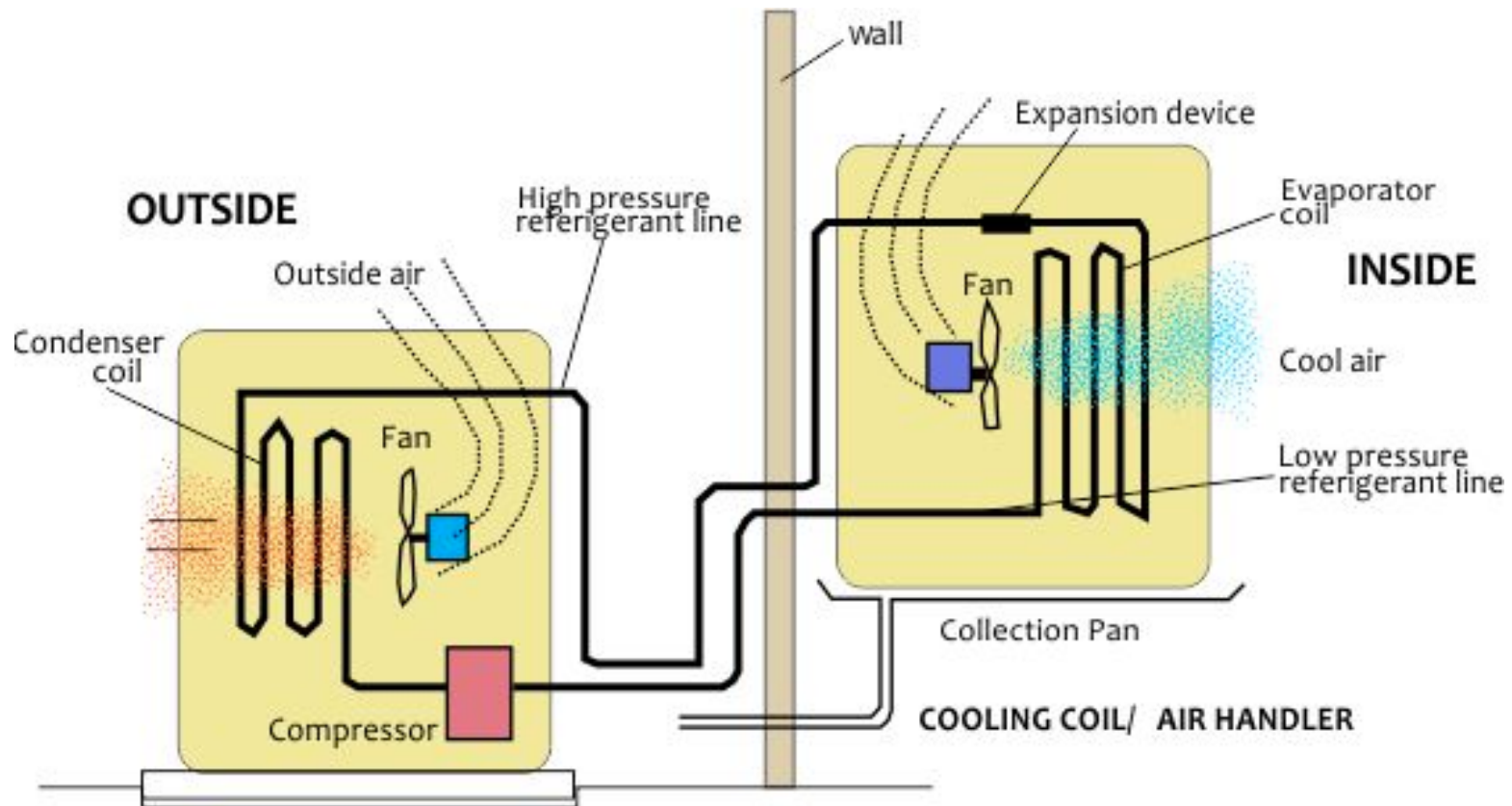
Refrigeration Systems

- A vapor compression cycle entails:



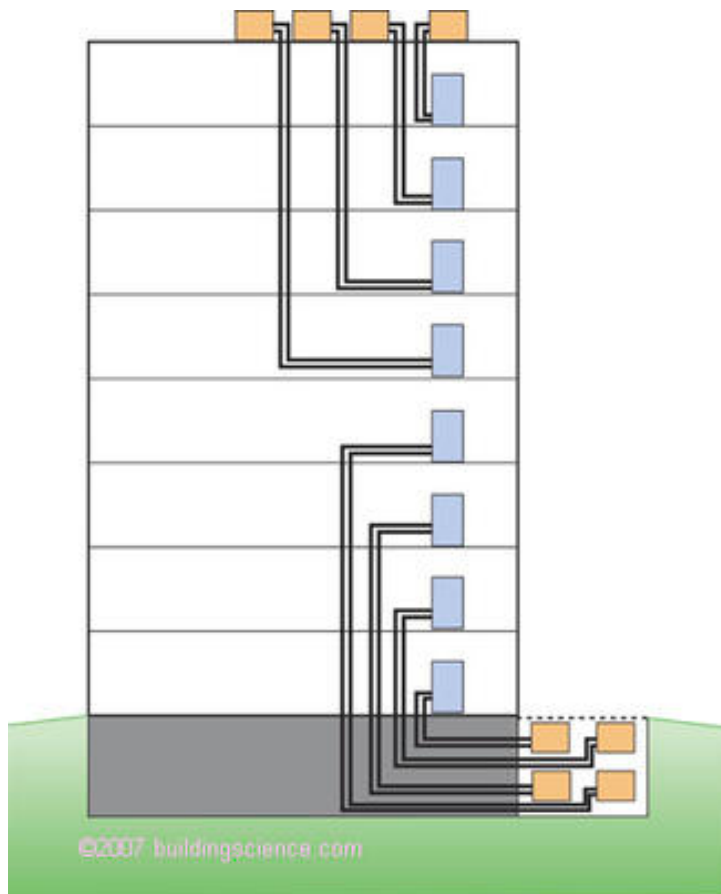
Refrigeration Systems

- An example of an application of the vapor compression cycle in a residential building is:



Refrigeration Systems

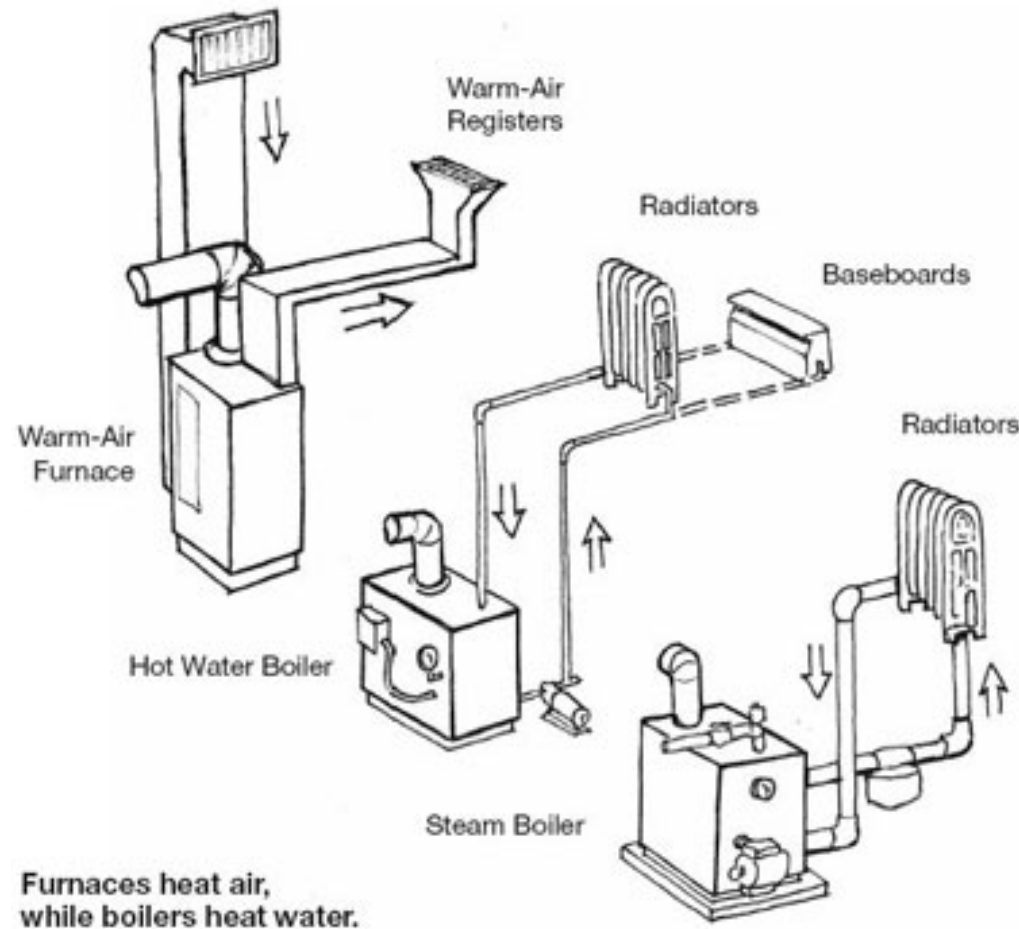
- An example of installing heat pump in a multi-family building



INTRODUCTION TO HEATING SYSTEMS

Heating Systems

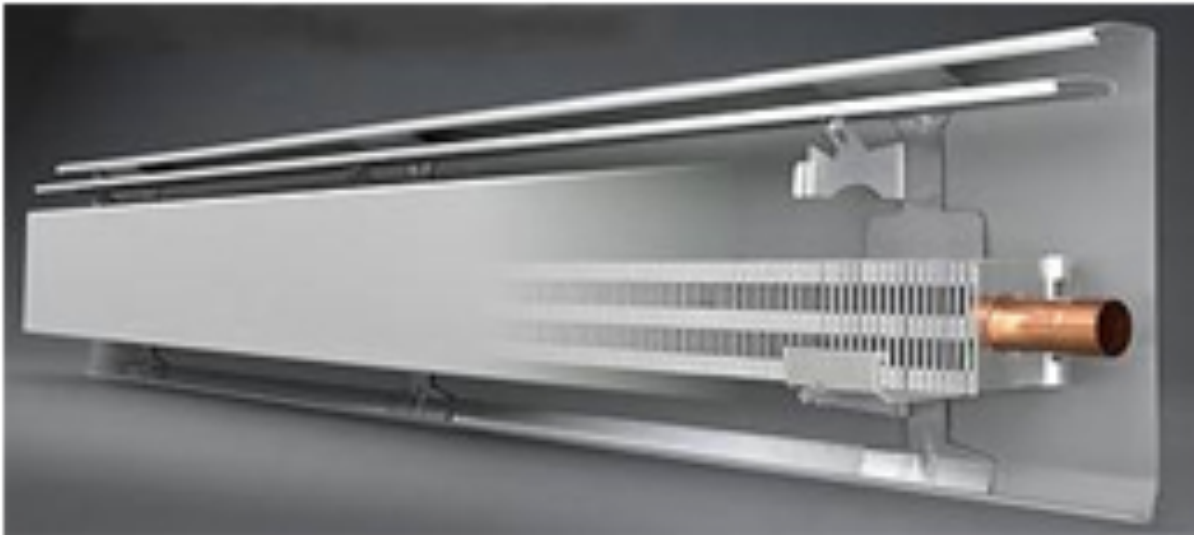
- Majority of single family homes in the U.S. use “furnace”



What's the main difference between furnace and boiler?

Heating Systems

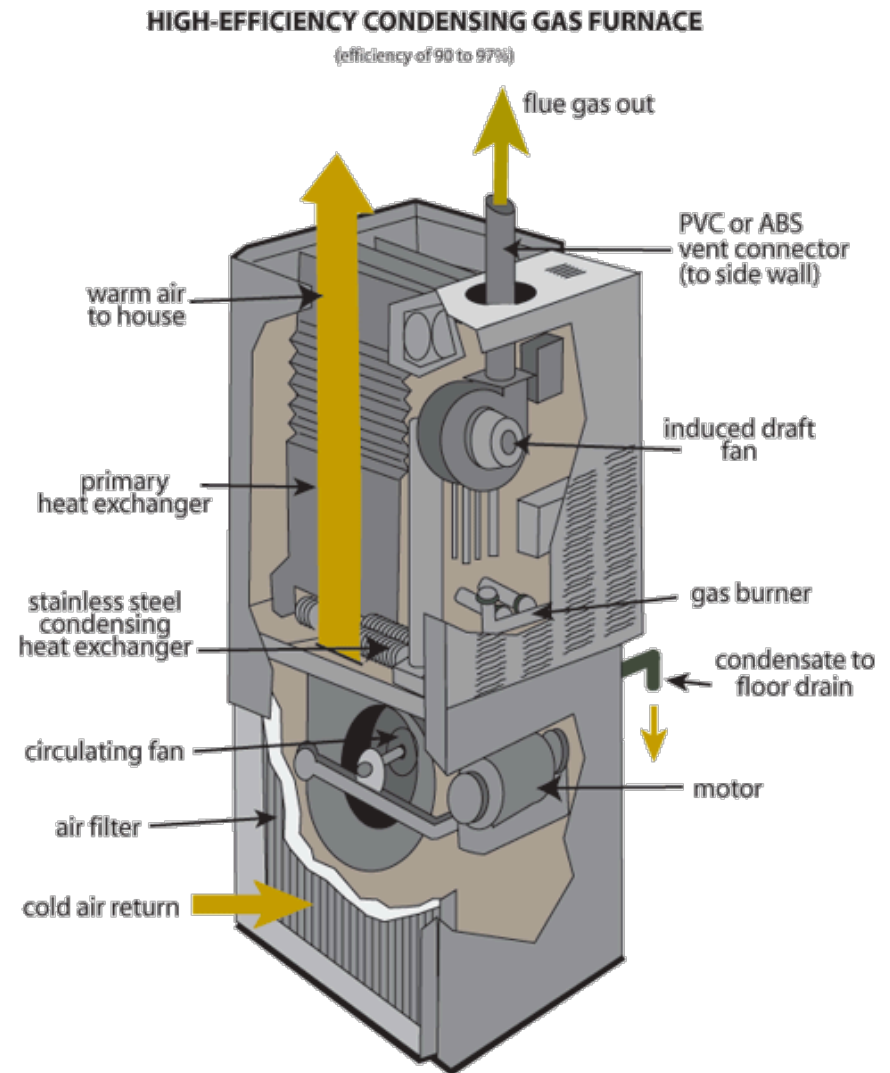
- Hydronic vs electric baseboards considerations:
 - Initial cost
 - Energy efficiency
 - Performance (e.g., warm up and duration)



Heating Systems

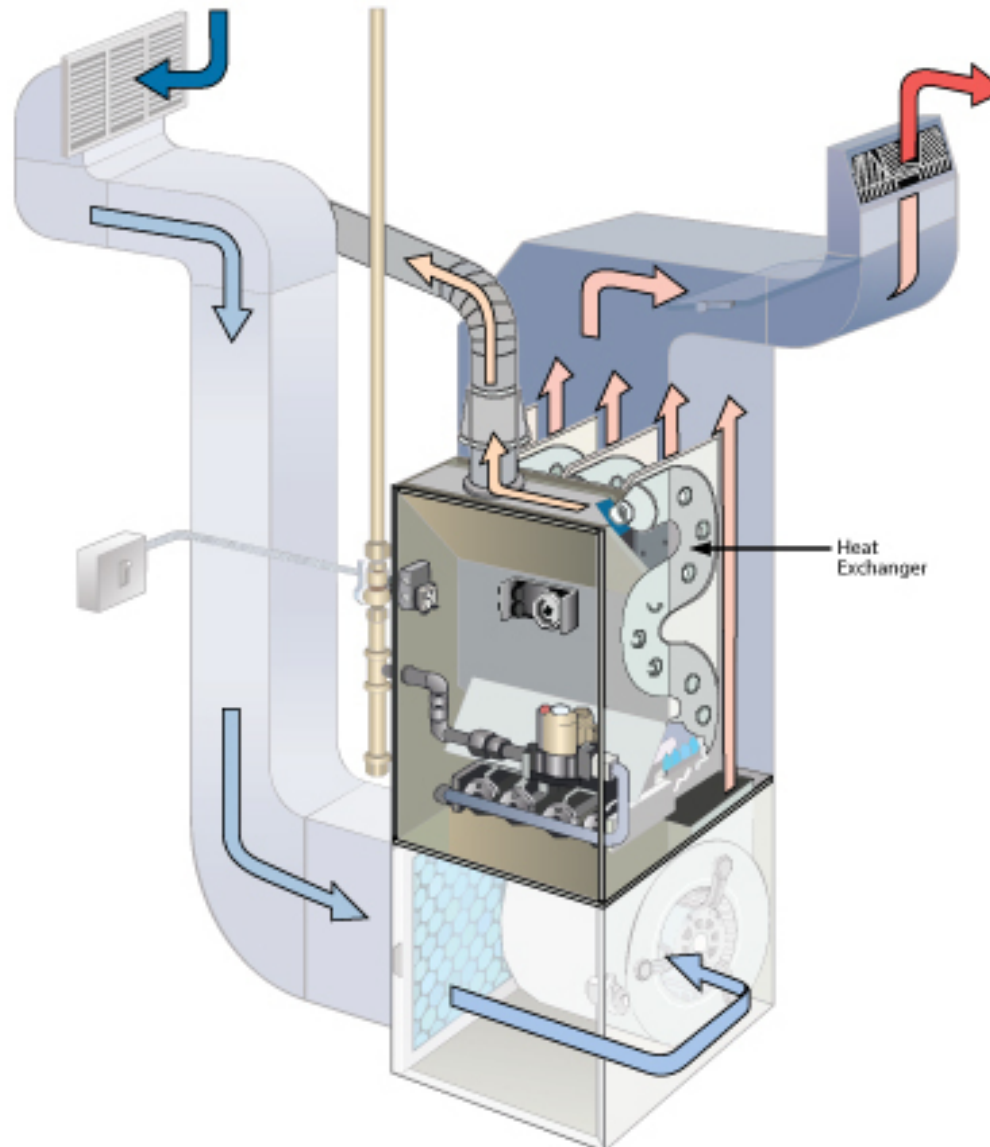
- Furnace:

- ❑ Deliver hot air through a central furnace and ductwork to the zones through registers or grills
- ❑ Named as a ducted warm-air or a forced warm-air distribution system
- ❑ The combustion heat is transferred via a heat exchanger to air
- ❑ Fan or “Blower” push the air through the ductwork
- ❑ Vent the byproducts to atmosphere
- ❑ Use induced fan and temperature control of exhaust (140 F) to recover energy in condensing furnaces



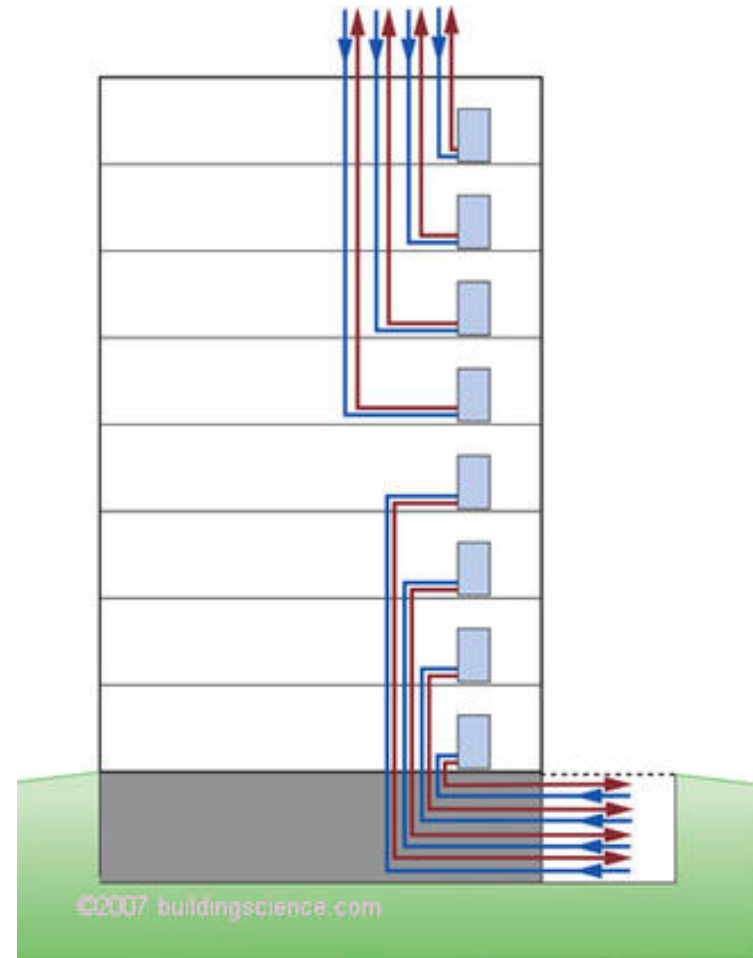
Heating Systems

- Furnace:



Heating Systems

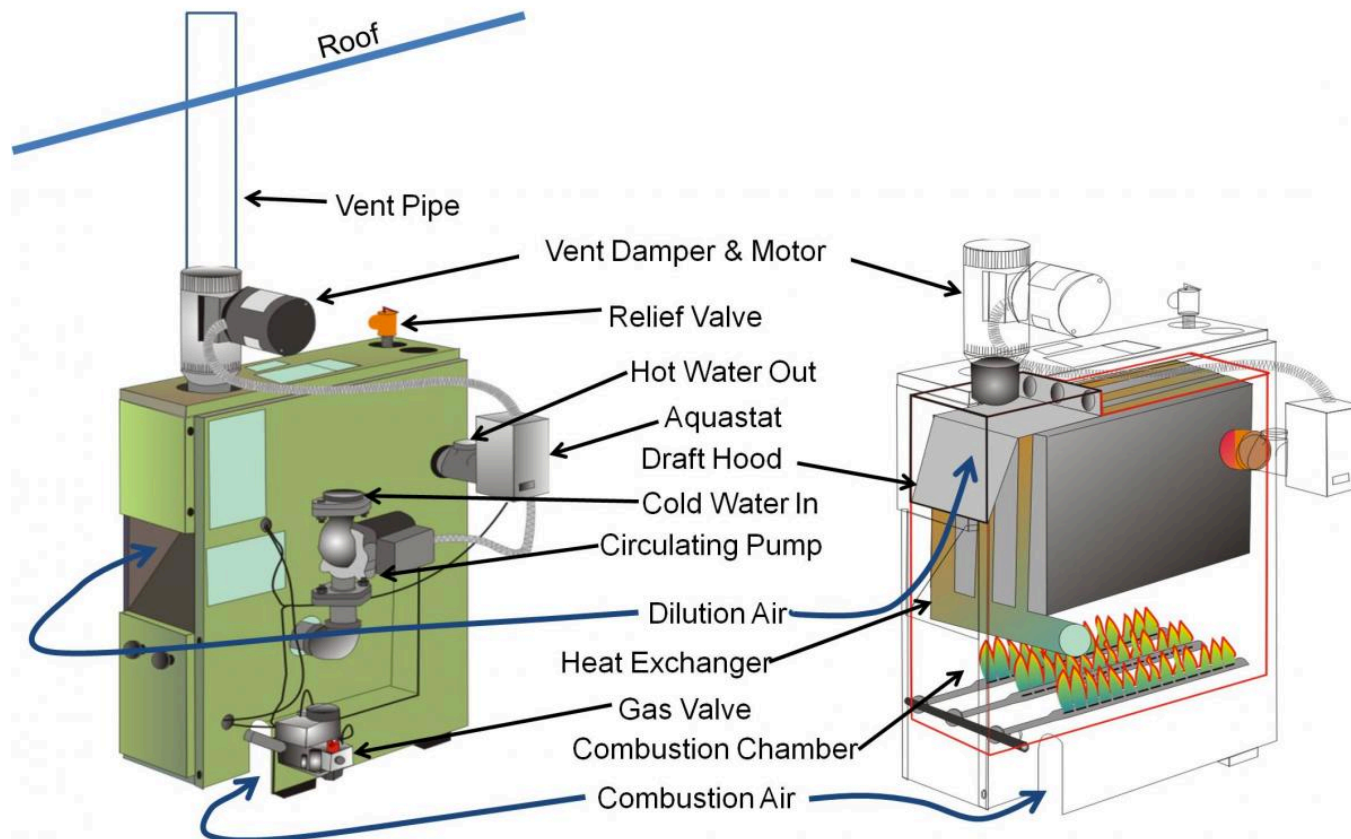
- Example of installing a furnace in a multi-family building:



Heating Systems

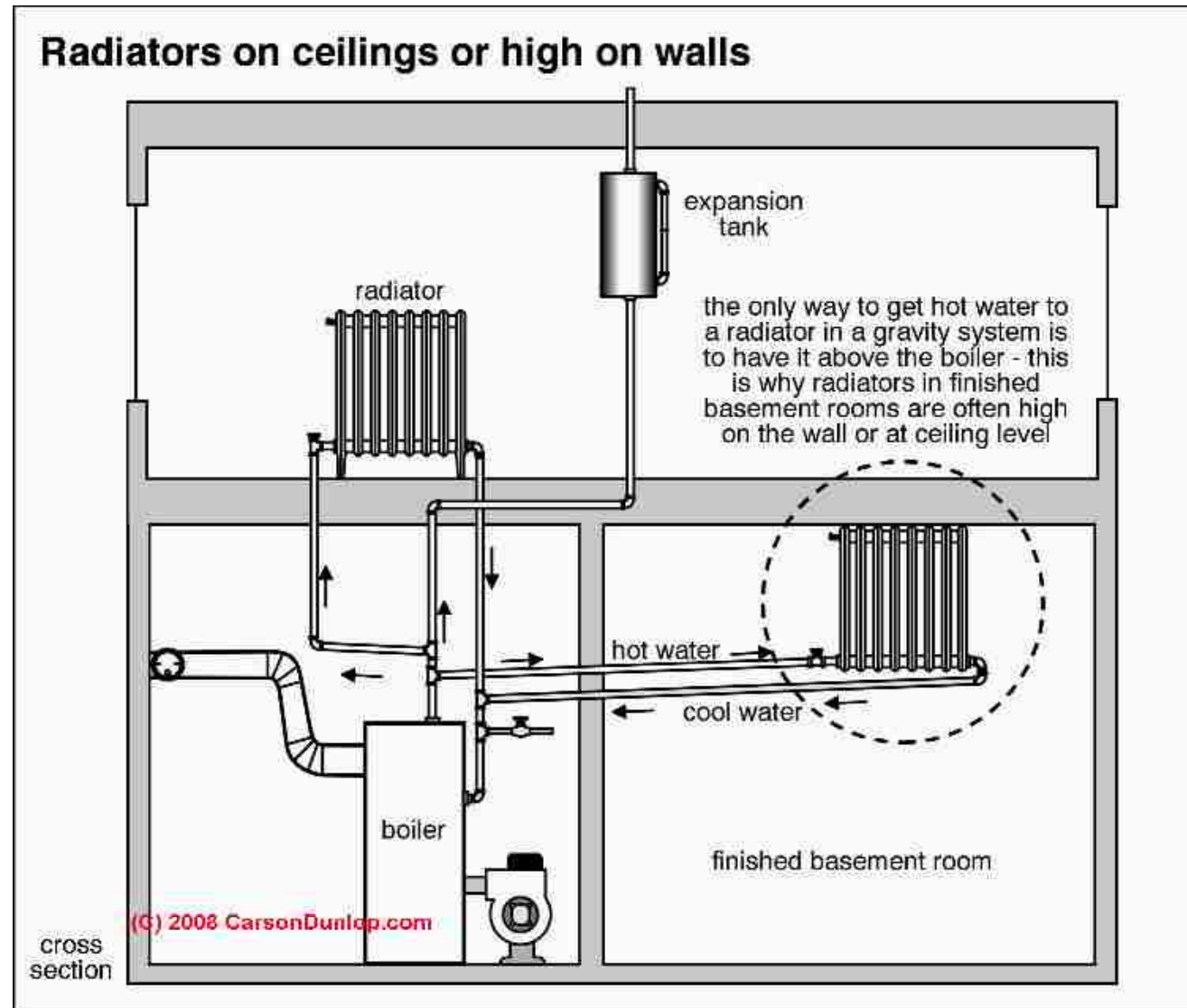
- Boilers

- ❑ Instead of air, they warm water “or steam” and distribute it
- ❑ It is a closed system
- ❑ Named as hydronic systems



Heating Systems

- Boilers



Heating Systems

- Heat Pumps
 - ❑ Two types of air-source and ground-source
 - ❑ Use outside as a heat sink in summer and heat source in winter



INTRODUCTION TO UNITARY SYSTEMS

Unitary

- Unitary or packaged terminal unit:
 - ❑ All components are factory assembled into major pieces (1-2 pieces)
 - ❑ Coils, fans, controls, .. are all included one major package
 - ❑ Named as decentralized system
 - ❑ Easy to install
 - ❑ Suitable for small to mid size buildings (Less than three stories)
 - ❑ Offices, motels, hotels
 - ❑ 5 to 460 kW (1.5 tons to 130 tons)
 - ❑ Lower initial cost and 10-15 years
 - ❑ Less efficient
 - ❑ Require maintenance
 - ❑ Can be used for perimeter zones

What's the main working fluid?

Can you distinguish primary and secondary systems here?

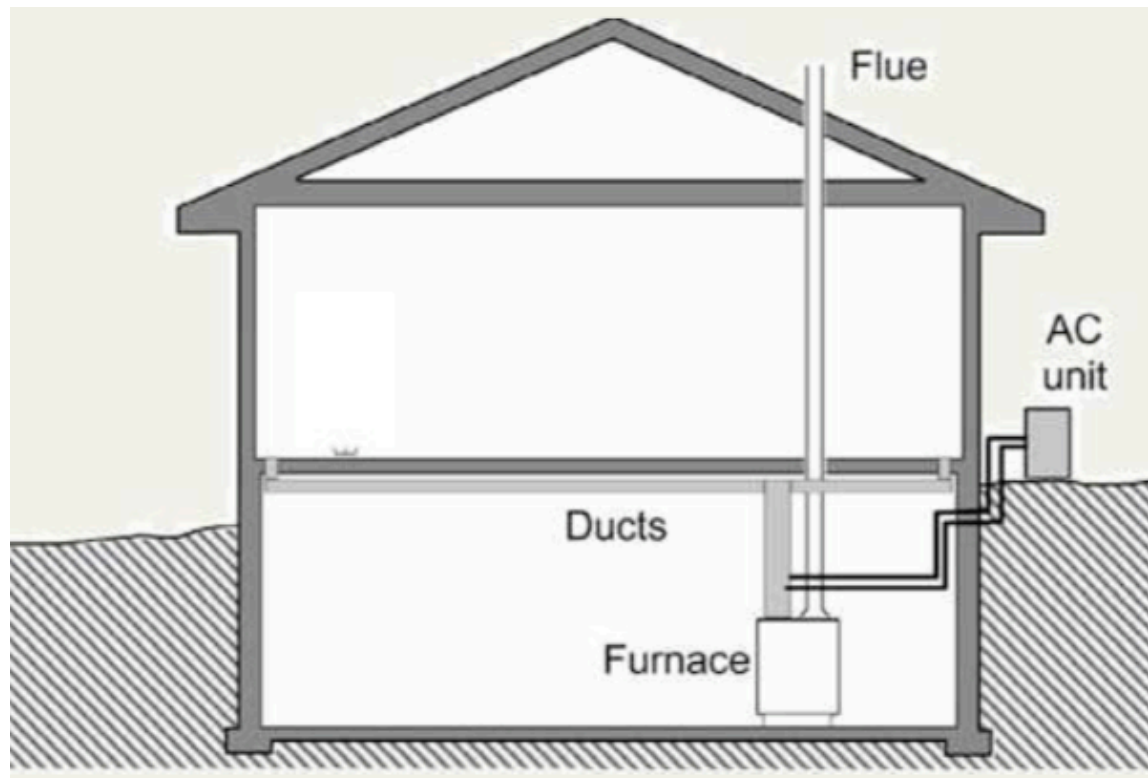
Unitary

- One type of unitary or packaged terminal unit is Packaged Terminal Air Conditioning (PTAC). For example:
 - ❑ A 15,000 BTU self-contained AC system in my office



Unitary

- Residential unitary systems
 - ❑ Two separate systems:
 - Furnace: Heating
 - AC: Cooling
 - ❑ Minimum maintenance required to change filter



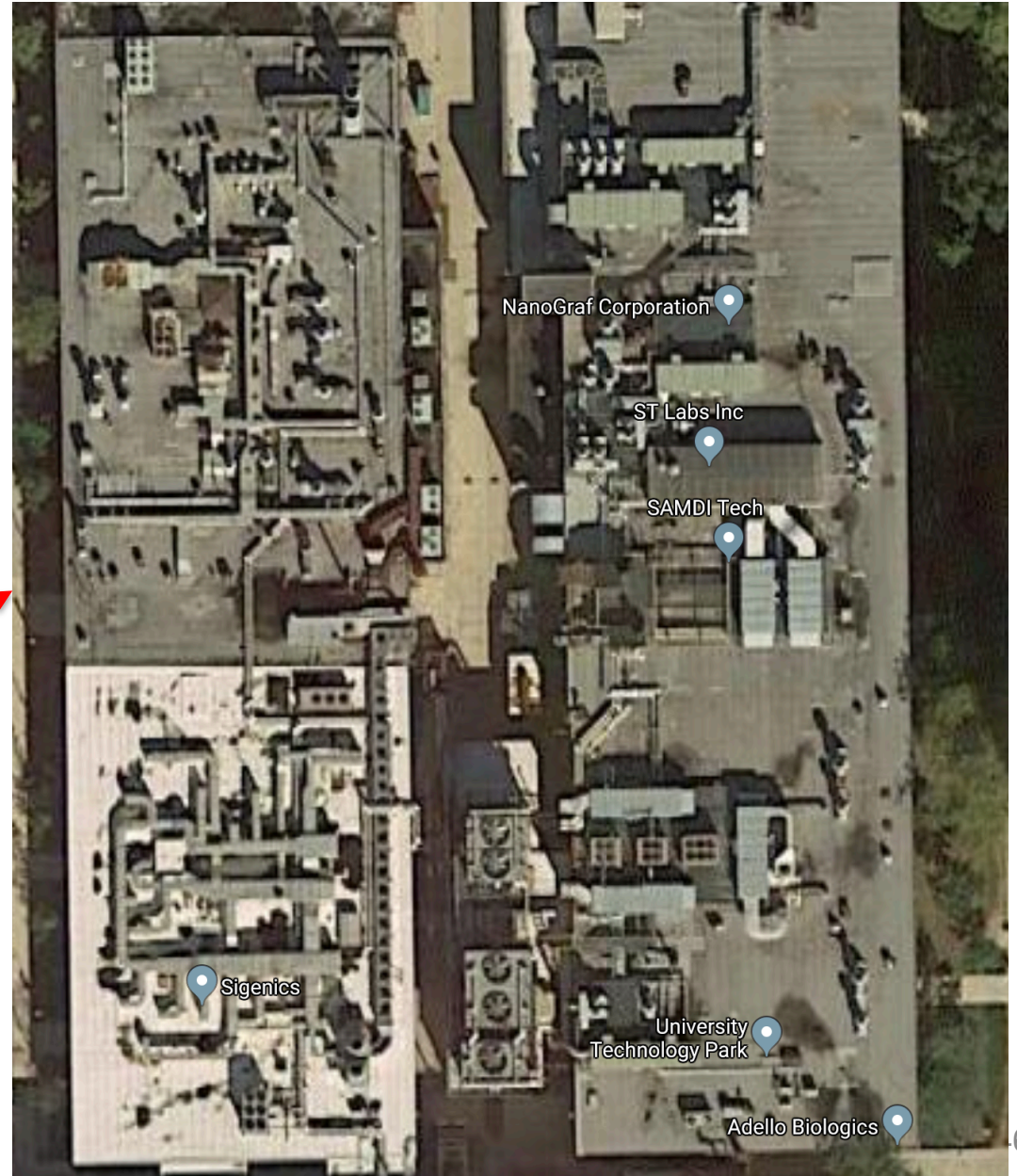
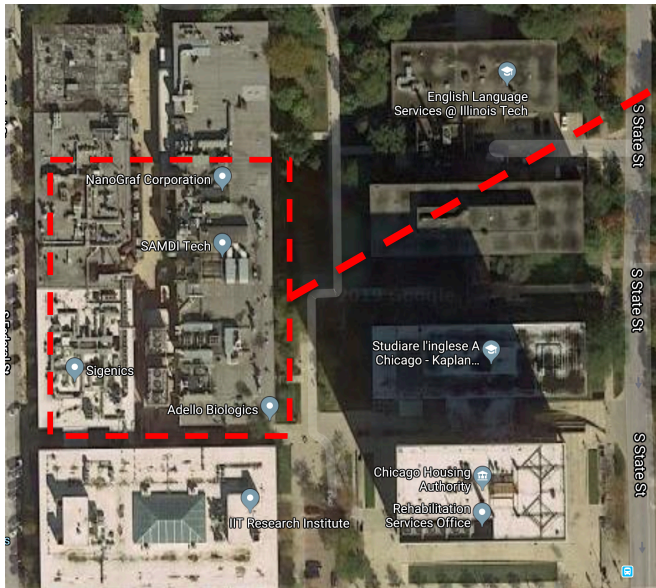
Split Systems

- Split systems:
 - ❑ Newer version of unitary systems
 - ❑ Heat transfer occurs through coils
 - ❑ Condenser coils and the compressor of the refrigerant outside
 - ❑ Evaporator coil or (DX)



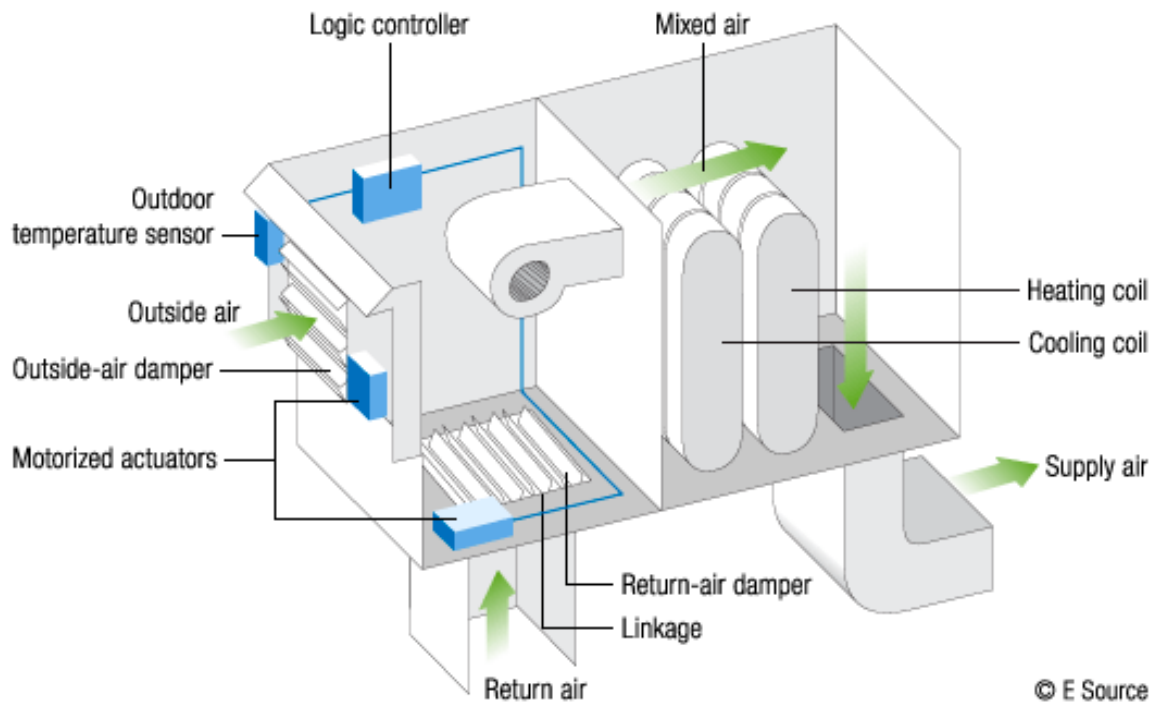
Split Systems

- What do you see here?



Unitary

- Rooftop units or packaged unit
 - ❑ DX Coil
 - ❑ Gas heating

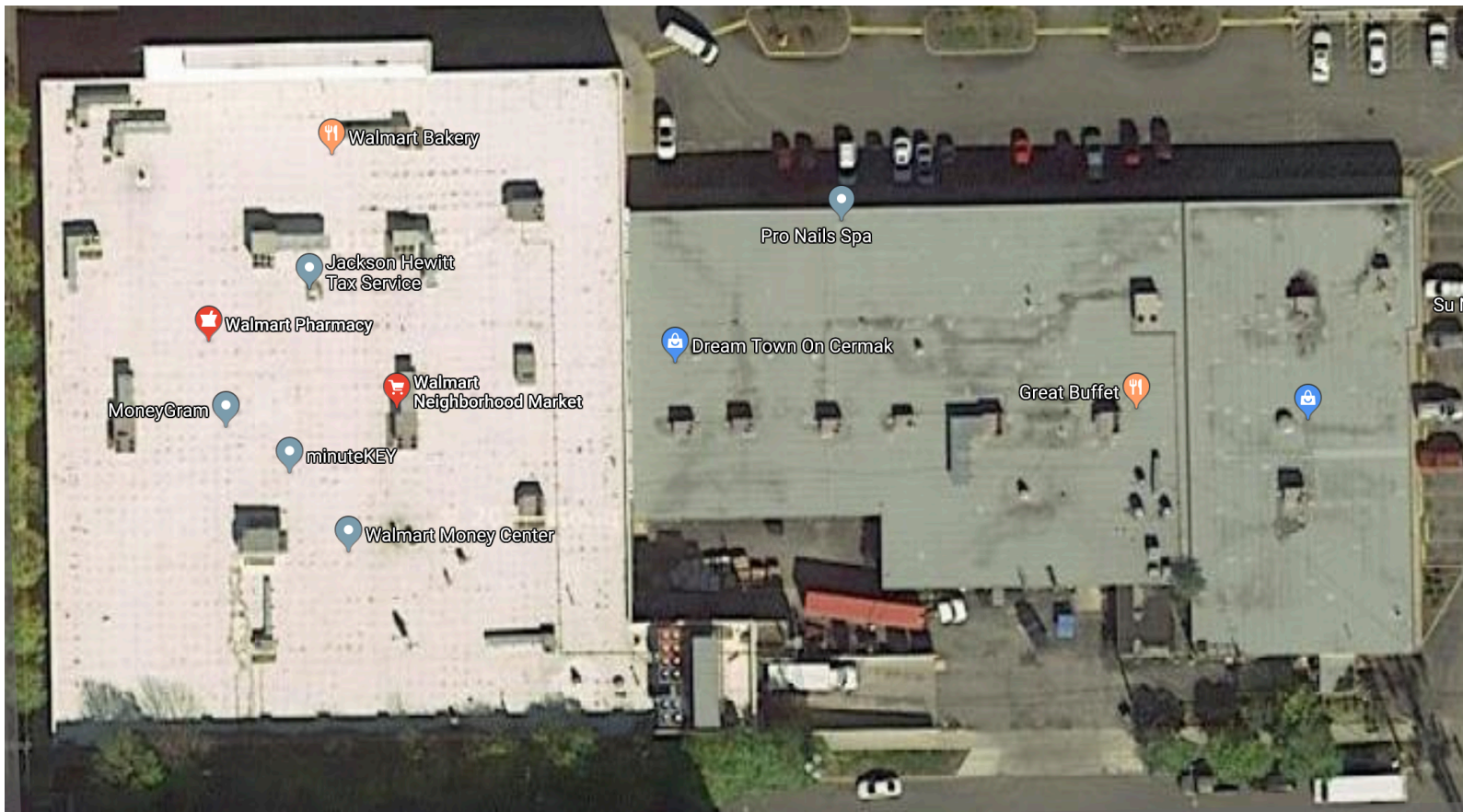


© E Source



Unitary

- Rooftop units or package unit
 - ❑ Suitable for store boxes “retail” or low-rise offices
 - ❑ Can serve different zones



Packaged Equipment

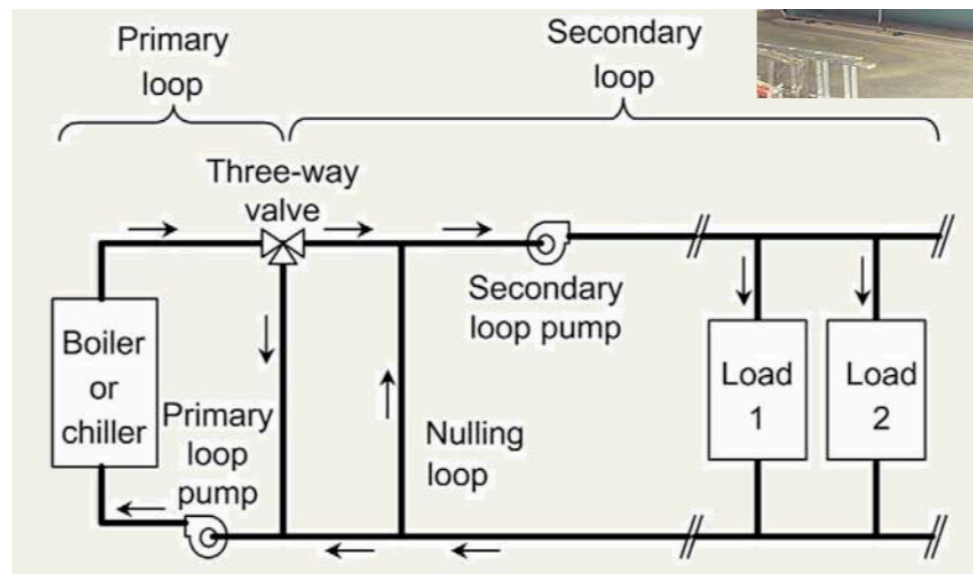
- Advantages and disadvantages of packaged equipment

Disadvantages	Advantages
Limited performance due to fixed sizing	Individual control is allowed
Limited humidity control	Simultaneous heating and cooling
Mostly on-off meaning swing in room temperature	Ventilation can be included
Short life span	Certified capacity by the manufacturer
Less efficient due to oversizing	Turn off units for unoccupied zones
Limited air distribution option	Simple operation
Complexity in using economizers	Low first cost
Noisy	No duct work
Poor aesthetics	Simple installation
Limited air filtering options	
Maintenance issues	

INTRODUCTION TO CENTRALIZED SYSTEMS

Centralized Systems

- Centralized systems:
 - ❑ Include various components and contractor needs to put together the system
 - ❑ Suitable for medium to large buildings
 - ❑ Hydronic system is an example of this system
 - ❑ Radiators are obsolete
 - ❑ More efficient heat transfer are fan coil units



Centralized Systems

- Centralized systems:



INTRODUCTION TO DISTRICT SYSTEMS

District Systems

- District systems:
 - ❑ Usually requires for campuses and neighborhoods
 - ❑ Suitable for a collection of building with different load profiles
 - ❑ Include different loops, chilled water or steam loops
 - ❑ Typically well-insulated or buried
 - ❑ Heat transfer at the building level
 - ❑ Primary loop setpoint 35 °F to 45 °F (1.7 °C to 7.2 °C) about 5 °F to 10 °F (2.7 °C to 5.5 °C) below the secondary temperature 40 °F to 50 °F (4.4 °C to 10 °C)

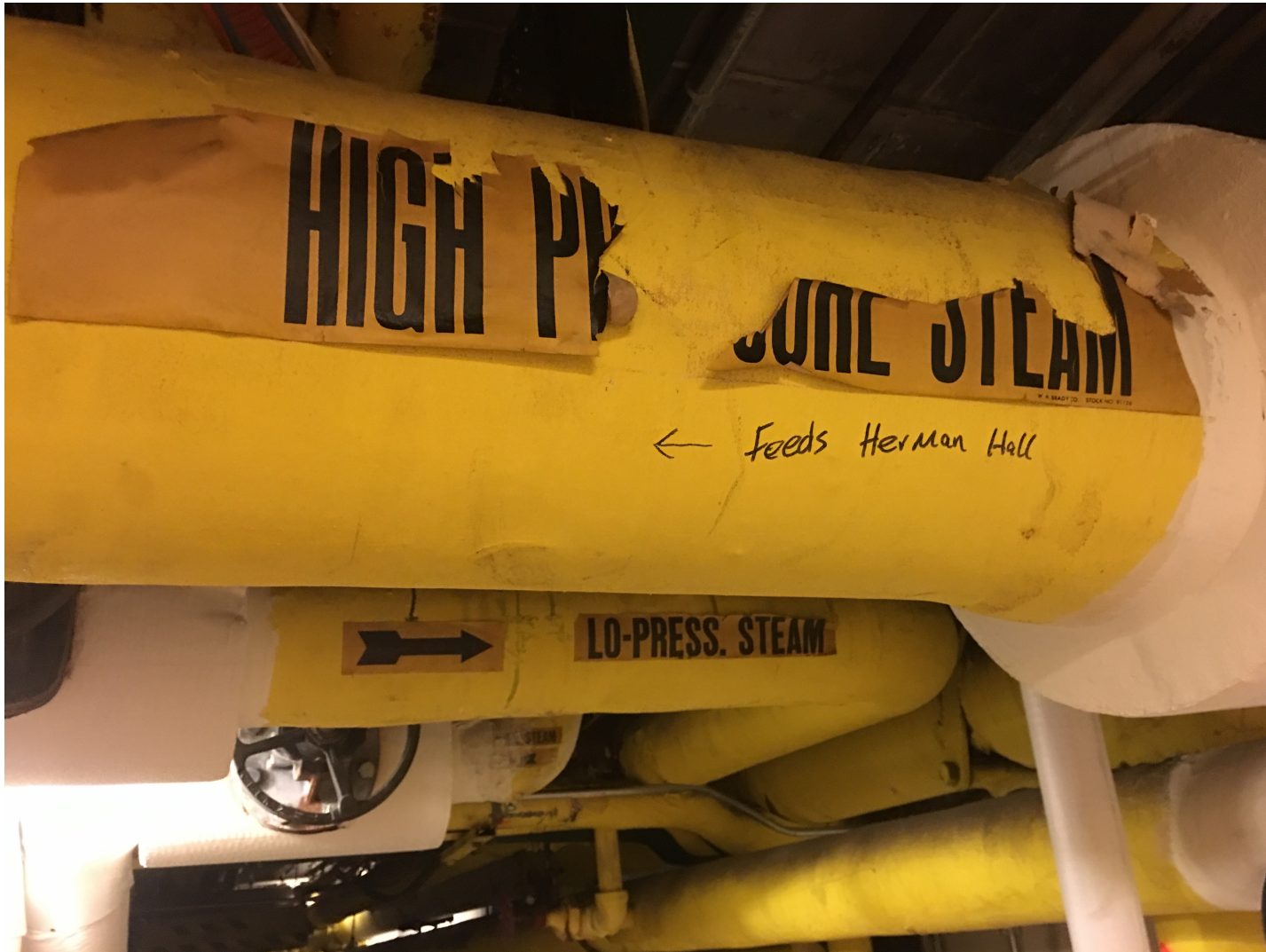
District Systems

- IIT Heating plant

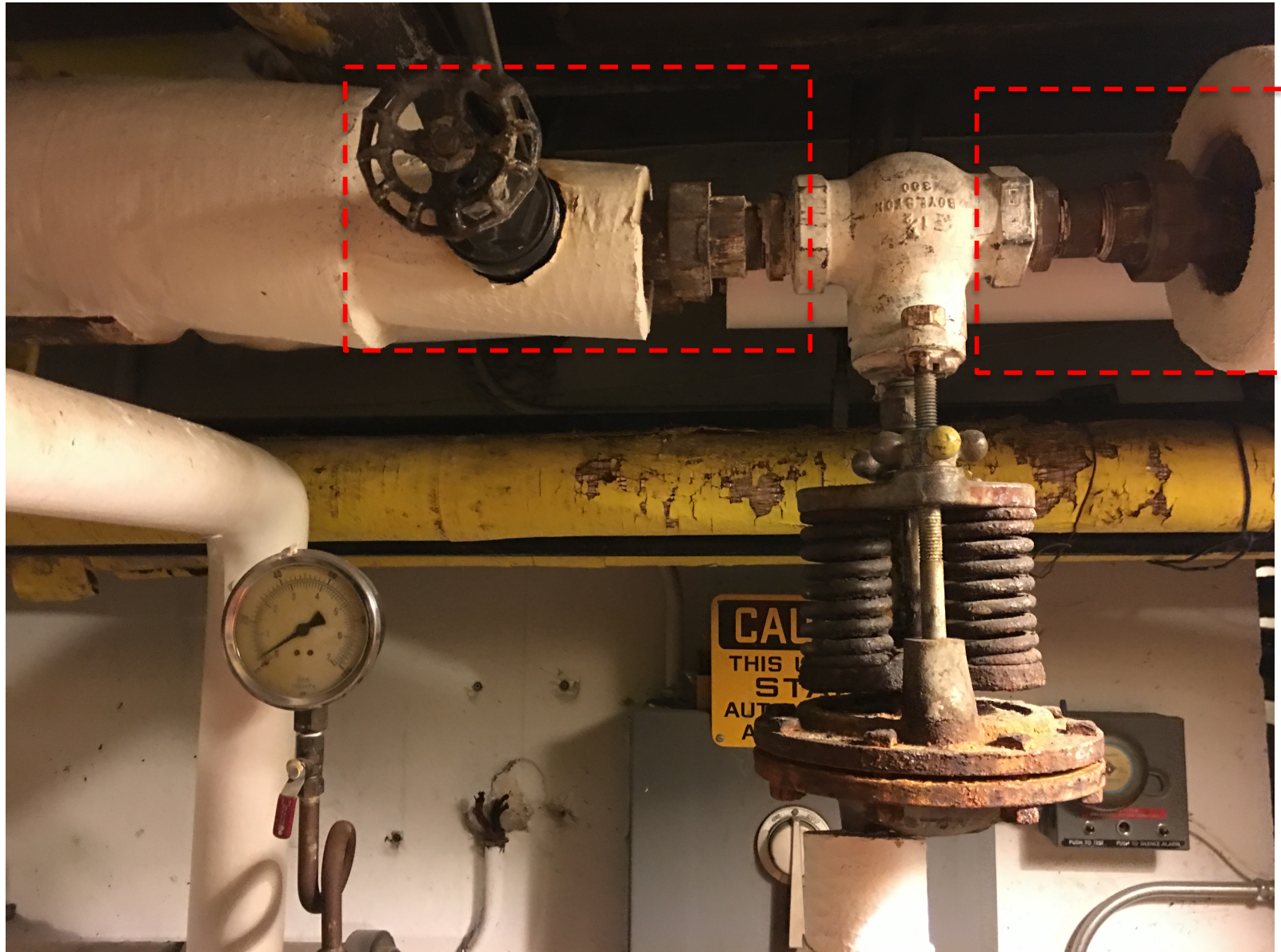


District Systems

- Alumni Hall and Herman Hall buildings steam system

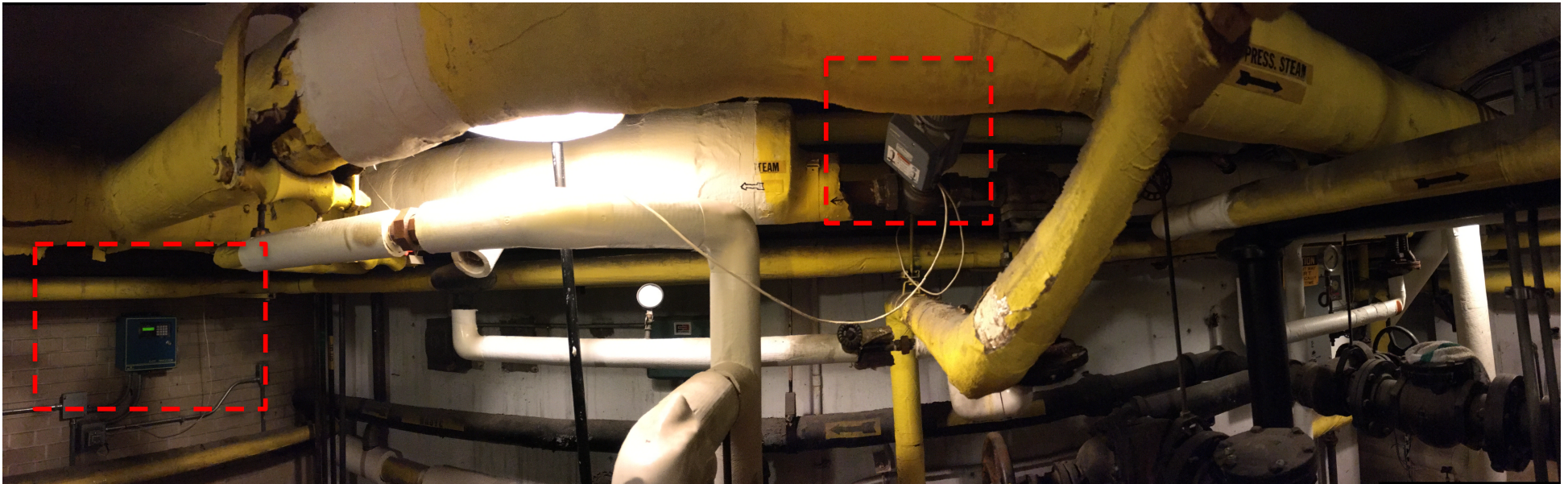


District Systems



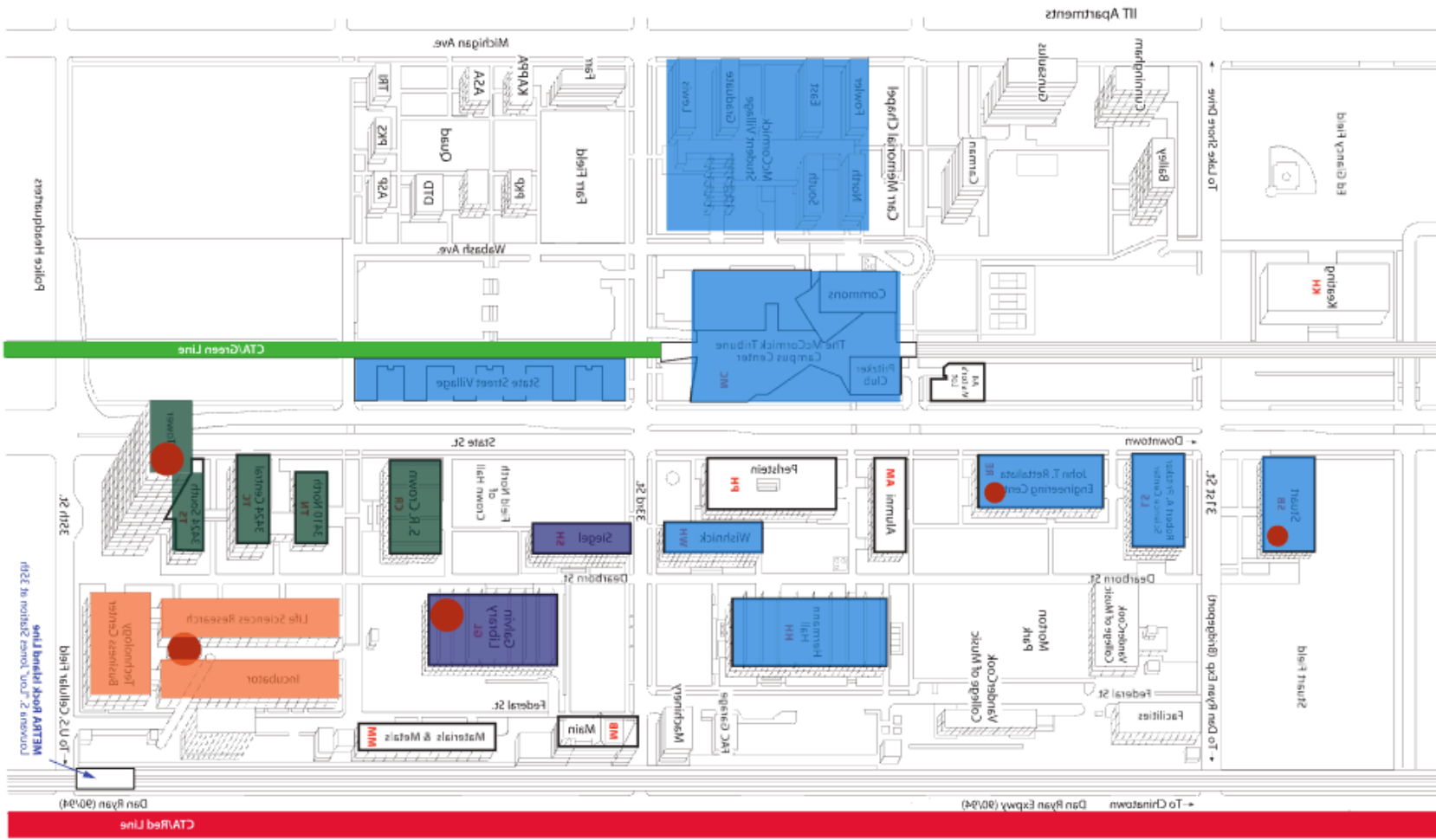
District Systems

- Alumni Hall and Herman Hall buildings steam system



District Systems

- IIT Cooling plant



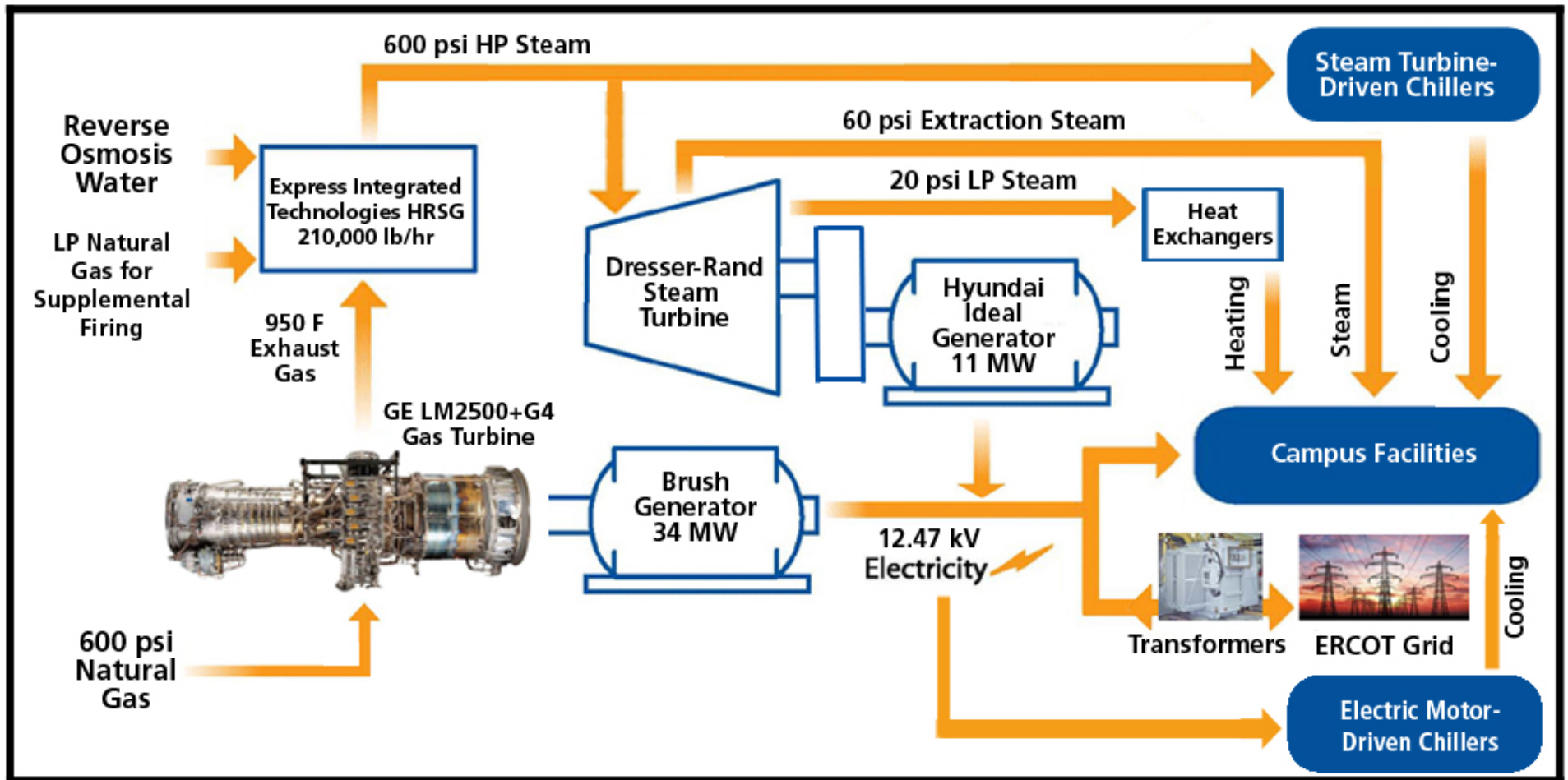
District Systems

- Example of other campuses: Hershey Medical Center
 - Three chiller plants
 - 12 chillers
 - Cool 2.6 million square feet
 - Two hospitals, five institutes and College of Medicine



District Systems

- A combined heat and power example at a campus:



HVAC SYSTEM DRAWINGS

HVAC System Drawings

- Please, see Chapter 38 of ASHRAE Fundamentals: Abbreviations and Symbols. This chapter entails:
 - Abbreviations
 - Letter symbols
 - Graphical symbols

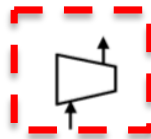
HVAC System Drawings

- Few examples of the graphical symbols:

Refrigeration

Compressors

Centrifugal



Reciprocating



Rotary

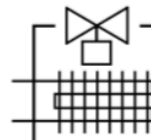


Rotary screw

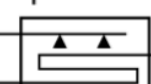


Condensers

Air cooled



Evaporative



Water cooled, (specify type)



Condensing Units

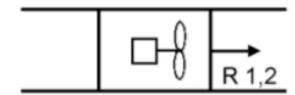
Air cooled^b



Air Moving Devices and Components

Fans (indicate use)^a

Axial flow



Centrifugal



Propeller



Roof ventilator, intake



Roof ventilator, exhaust



Roof ventilator, louvered

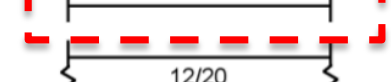


Ductwork^b

Direction of flow



Duct size, first figure is side down



Duct section, positive pressure, first figure is top



Duct section, negative pressure



Change of elevation
rise (R) drop (D)



HVAC System Drawings

- It is a good practice in the drawings to:
 - Include list of all drawing files in the drawing cover page
 - Name files based on the file number, building name, drawing type
 - A: Architectural
 - S: Structural
 - M: Mechanical
 - Pay attention to the example drawings provided for Wishnick Hall
 - Files are available on Blackboard
 - “0-0”: Symbols
 - “1-x”: Ductwork (If there is a demolition plan it is usually 1-x and the rest start at 2-x)
 - “3-x”: Piping
 - “4-x”: Sections
 - “5-x”: Controls (It can go to “6-x” and more than that)
 - “6-x”: Mechanical schedules (It is the last one usually)

HVAC System Drawings

- Wishnick Hall

WISHNICK LEARNING CENTER BUILDING RESTORATION AND RENOVATION



3255 South Dearborn Street
Illinois Institute of Technology
Chicago, Illinois 60616

PROPOSAL REQUEST #6, 06-17-05
POLYMER CENTER TENANT BUILD-OUT

ARCHITECTURAL ABBREVIATIONS ARCHITECTURAL SYMBOLS LIST

ABBREVIATION	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL
AB	ABOVE		SEE WET WALL SYMBOLS	
AC	ACROSSING		1/8" WET WALL	
AD	ADDENDUM		1/2" WET WALL	
AE	ADDENDUM		3/4" WET WALL	
AF	ADDENDUM		1" WET WALL	
AG	ADDENDUM		1 1/2" WET WALL	
AH	ADDENDUM		2" WET WALL	
AI	ADDENDUM		3" WET WALL	
AJ	ADDENDUM		4" WET WALL	
AK	ADDENDUM		5" WET WALL	
AL	ADDENDUM		6" WET WALL	
AM	ADDENDUM		7" WET WALL	
AN	ADDENDUM		8" WET WALL	
AO	ADDENDUM		9" WET WALL	
AP	ADDENDUM		10" WET WALL	
AQ	ADDENDUM		11" WET WALL	
AR	ADDENDUM		12" WET WALL	
AS	ADDENDUM		13" WET WALL	
AT	ADDENDUM		14" WET WALL	
AU	ADDENDUM		15" WET WALL	
AV	ADDENDUM		16" WET WALL	
AW	ADDENDUM		17" WET WALL	
AX	ADDENDUM		18" WET WALL	
AY	ADDENDUM		19" WET WALL	
AZ	ADDENDUM		20" WET WALL	
BA	ADDENDUM		21" WET WALL	
BB	ADDENDUM		22" WET WALL	
BC	ADDENDUM		23" WET WALL	
BD	ADDENDUM		24" WET WALL	
BE	ADDENDUM		25" WET WALL	
BF	ADDENDUM		26" WET WALL	
BG	ADDENDUM		27" WET WALL	
BH	ADDENDUM		28" WET WALL	
BI	ADDENDUM		29" WET WALL	
BJ	ADDENDUM		30" WET WALL	
BK	ADDENDUM		31" WET WALL	
BL	ADDENDUM		32" WET WALL	
BM	ADDENDUM		33" WET WALL	
BN	ADDENDUM		34" WET WALL	
BO	ADDENDUM		35" WET WALL	
BP	ADDENDUM		36" WET WALL	
BQ	ADDENDUM		37" WET WALL	
BR	ADDENDUM		38" WET WALL	
BS	ADDENDUM		39" WET WALL	
BT	ADDENDUM		40" WET WALL	
BU	ADDENDUM		41" WET WALL	
BV	ADDENDUM		42" WET WALL	
BW	ADDENDUM		43" WET WALL	
BX	ADDENDUM		44" WET WALL	
BY	ADDENDUM		45" WET WALL	
BZ	ADDENDUM		46" WET WALL	
CA	ADDENDUM		47" WET WALL	
CB	ADDENDUM		48" WET WALL	
CC	ADDENDUM		49" WET WALL	
CD	ADDENDUM		50" WET WALL	
CE	ADDENDUM		51" WET WALL	
CF	ADDENDUM		52" WET WALL	
CG	ADDENDUM		53" WET WALL	
CH	ADDENDUM		54" WET WALL	
CI	ADDENDUM		55" WET WALL	
CJ	ADDENDUM		56" WET WALL	
CK	ADDENDUM		57" WET WALL	
CL	ADDENDUM		58" WET WALL	
CM	ADDENDUM		59" WET WALL	
CN	ADDENDUM		60" WET WALL	
CO	ADDENDUM		61" WET WALL	
CP	ADDENDUM		62" WET WALL	
CQ	ADDENDUM		63" WET WALL	
CR	ADDENDUM		64" WET WALL	
CS	ADDENDUM		65" WET WALL	
CT	ADDENDUM		66" WET WALL	
CU	ADDENDUM		67" WET WALL	
CV	ADDENDUM		68" WET WALL	
CW	ADDENDUM		69" WET WALL	
CX	ADDENDUM		70" WET WALL	
CY	ADDENDUM		71" WET WALL	
CZ	ADDENDUM		72" WET WALL	
DA	ADDENDUM		73" WET WALL	
DB	ADDENDUM		74" WET WALL	
DC	ADDENDUM		75" WET WALL	
DD	ADDENDUM		76" WET WALL	
DE	ADDENDUM		77" WET WALL	
DF	ADDENDUM		78" WET WALL	
DG	ADDENDUM		79" WET WALL	
DH	ADDENDUM		80" WET WALL	
DI	ADDENDUM		81" WET WALL	
DJ	ADDENDUM		82" WET WALL	
DK	ADDENDUM		83" WET WALL	
DL	ADDENDUM		84" WET WALL	
DM	ADDENDUM		85" WET WALL	
DN	ADDENDUM		86" WET WALL	
DO	ADDENDUM		87" WET WALL	
DP	ADDENDUM		88" WET WALL	
DQ	ADDENDUM		89" WET WALL	
DR	ADDENDUM		90" WET WALL	
DS	ADDENDUM		91" WET WALL	
DT	ADDENDUM		92" WET WALL	
DU	ADDENDUM		93" WET WALL	
DV	ADDENDUM		94" WET WALL	
DW	ADDENDUM		95" WET WALL	
DX	ADDENDUM		96" WET WALL	
DY	ADDENDUM		97" WET WALL	
DZ	ADDENDUM		98" WET WALL	
EA	ADDENDUM		99" WET WALL	
EB	ADDENDUM		100" WET WALL	
EC	ADDENDUM		101" WET WALL	
ED	ADDENDUM		102" WET WALL	
EE	ADDENDUM		103" WET WALL	
EF	ADDENDUM		104" WET WALL	
EG	ADDENDUM		105" WET WALL	
EH	ADDENDUM		106" WET WALL	
EI	ADDENDUM		107" WET WALL	
EJ	ADDENDUM		108" WET WALL	
EK	ADDENDUM		109" WET WALL	
EL	ADDENDUM		110" WET WALL	
EM	ADDENDUM		111" WET WALL	
EN	ADDENDUM		112" WET WALL	
EO	ADDENDUM		113" WET WALL	
EP	ADDENDUM		114" WET WALL	
EQ	ADDENDUM		115" WET WALL	
ER	ADDENDUM		116" WET WALL	
ES	ADDENDUM		117" WET WALL	
ET	ADDENDUM		118" WET WALL	
EU	ADDENDUM		119" WET WALL	
EV	ADDENDUM		120" WET WALL	
EW	ADDENDUM		121" WET WALL	
EX	ADDENDUM		122" WET WALL	
EY	ADDENDUM		123" WET WALL	
EZ	ADDENDUM		124" WET WALL	
FA	ADDENDUM		125" WET WALL	
FB	ADDENDUM		126" WET WALL	
FC	ADDENDUM		127" WET WALL	
FD	ADDENDUM		128" WET WALL	
FE	ADDENDUM		129" WET WALL	
FF	ADDENDUM		130" WET WALL	
FG	ADDENDUM		131" WET WALL	
FH	ADDENDUM		132" WET WALL	
FI	ADDENDUM		133" WET WALL	
FJ	ADDENDUM		134" WET WALL	
FK	ADDENDUM		135" WET WALL	
FL	ADDENDUM		136" WET WALL	
FM	ADDENDUM		137" WET WALL	
FN	ADDENDUM		138" WET WALL	
FO	ADDENDUM		139" WET WALL	
FP	ADDENDUM		140" WET WALL	
FQ	ADDENDUM		141" WET WALL	
FR	ADDENDUM		142" WET WALL	
FS	ADDENDUM		143" WET WALL	
FT	ADDENDUM		144" WET WALL	
FU	ADDENDUM		145" WET WALL	
FV	ADDENDUM		146" WET WALL	
FW	ADDENDUM		147" WET WALL	
FX	ADDENDUM		148" WET WALL	
FY	ADDENDUM		149" WET WALL	
FZ	ADDENDUM		150" WET WALL	
GA	ADDENDUM		151" WET WALL	
GB	ADDENDUM		152" WET WALL	
GC	ADDENDUM		153" WET WALL	
GD	ADDENDUM		154" WET WALL	
GE	ADDENDUM		155" WET WALL	
GF	ADDENDUM		156" WET WALL	
GG	ADDENDUM		157" WET WALL	
GH	ADDENDUM		158" WET WALL	
GI	ADDENDUM		159" WET WALL	
GJ	ADDENDUM		160" WET WALL	
GK	ADDENDUM		161" WET WALL	
GL	ADDENDUM		162" WET WALL	
GM	ADDENDUM		163" WET WALL	
GN	ADDENDUM		164" WET WALL	
GO	ADDENDUM		165" WET WALL	
GP	ADDENDUM		166" WET WALL	
GQ	ADDENDUM		167" WET WALL	
GR	ADDENDUM		168" WET WALL	
GS	ADDENDUM		169" WET WALL	
GT	ADDENDUM		170" WET WALL	
GU	ADDENDUM		171" WET WALL	
GV	ADDENDUM		172" WET WALL	
GW	ADDENDUM		173" WET WALL	
GX	ADDENDUM		174" WET WALL	
GY	ADDENDUM		175" WET WALL	
GZ	ADDENDUM		176" WET WALL	
HA	ADDENDUM		177" WET WALL	
HB	ADDENDUM		178" WET WALL	
HC	ADDENDUM		179" WET WALL	
HD	ADDENDUM		180" WET WALL	
HE	ADDENDUM		181" WET WALL	
HF	ADDENDUM		182" WET WALL	
HG	ADDENDUM		183" WET WALL	
HH	ADDENDUM		184" WET WALL	
HI	ADDENDUM		185" WET WALL	
HJ	ADDENDUM		186" WET WALL	
HK	ADDENDUM		187" WET WALL	
HL	ADDENDUM		188" WET WALL	
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HN	ADDENDUM		190" WET WALL	
HO	ADDENDUM		191" WET WALL	
HP	ADDENDUM		192" WET WALL	
HQ	ADDENDUM		193" WET WALL	
HR	ADDENDUM		194" WET WALL	
HS	ADDENDUM		195" WET WALL	
HT	ADDENDUM		196" WET WALL	
HU	ADDENDUM		197" WET WALL	
HV	ADDENDUM		198" WET WALL	
HW	ADDENDUM		199" WET WALL	
HX	ADDENDUM		200" WET WALL	
HY	ADDENDUM		201" WET WALL	
HZ	ADDENDUM		202" WET WALL	
IA	ADDENDUM		203" WET WALL	
IB	ADDENDUM		204" WET WALL	
IC	ADDENDUM		205" WET WALL	
ID	ADDENDUM		206" WET WALL	
IE	ADDENDUM		207" WET WALL	
IF	ADDENDUM		208" WET WALL	
IG	ADDENDUM		209" WET WALL	
IH	ADDENDUM		210" WET WALL	
II	ADDENDUM		211" WET WALL	
IJ	ADDENDUM		212" WET WALL	
IK	ADDENDUM		213" WET WALL	
IL	ADDENDUM		214" WET WALL	
IM	ADDENDUM		215" WET WALL	
IN	ADDENDUM		216" WET WALL	
IO	ADDENDUM		217" WET WALL	
IP	ADDENDUM		218" WET WALL	
IQ	ADDENDUM		219" WET WALL	
IR	ADDENDUM		220" WET WALL	
IS	ADDENDUM		221" WET WALL	
IT	ADDENDUM		222" WET WALL	
IU	ADDENDUM		223" WET WALL	
IV	ADDENDUM		224" WET WALL	
IW	ADDENDUM		225" WET WALL	
IX	ADDENDUM		226" WET WALL	
IY	ADDENDUM		227" WET WALL	
IZ	ADDENDUM		228" WET WALL	
JA	ADDENDUM		229" WET WALL	
JB	ADDENDUM		230" WET WALL	
JC	ADDENDUM		231" WET WALL	
JD	ADDENDUM		232" WET WALL	
JE	ADDENDUM		233" WET WALL	
JF	ADDENDUM		234" WET WALL	
JG	ADDENDUM		235" WET WALL	
JH	ADDENDUM		236" WET WALL	
JI	ADDENDUM		237" WET WALL	
JJ	ADDENDUM		238" WET WALL	
JK	ADDENDUM		239" WET WALL	
JL	ADDENDUM		240" WET WALL	
JM	ADDENDUM		241" WET WALL	
JN	ADDENDUM		242" WET WALL	
JO	ADDENDUM		243" WET WALL	
JP	ADDENDUM		244" WET WALL	
JQ	ADDENDUM		245" WET WALL	
JR	ADDENDUM		246" WET WALL	
JS	ADDENDUM		247" WET WALL	
JT	ADDENDUM		248" WET WALL	
JU	ADDENDUM		249" WET WALL	
JV	ADDENDUM		250" WET WALL	
JW	ADDENDUM		251" WET WALL	
JX	ADDENDUM		252" WET WALL	
JY	ADDENDUM		253" WET WALL	
JZ	ADDENDUM		254" WET WALL	
KA	ADDENDUM		255" WET WALL	
KB	ADDENDUM		256" WET WALL	
KC	ADDENDUM			

HVAC System Drawings

- Wishnick Hall

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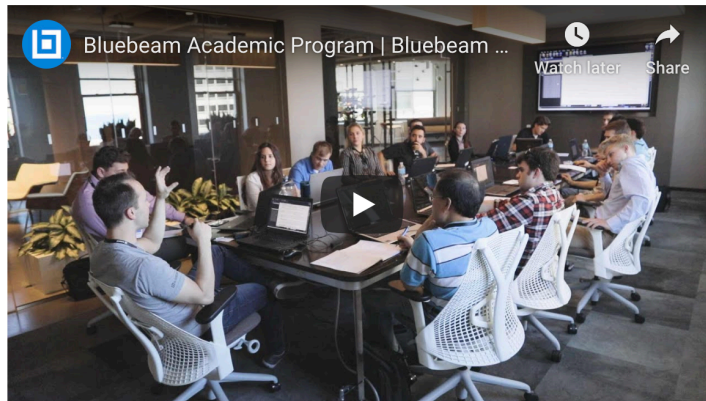
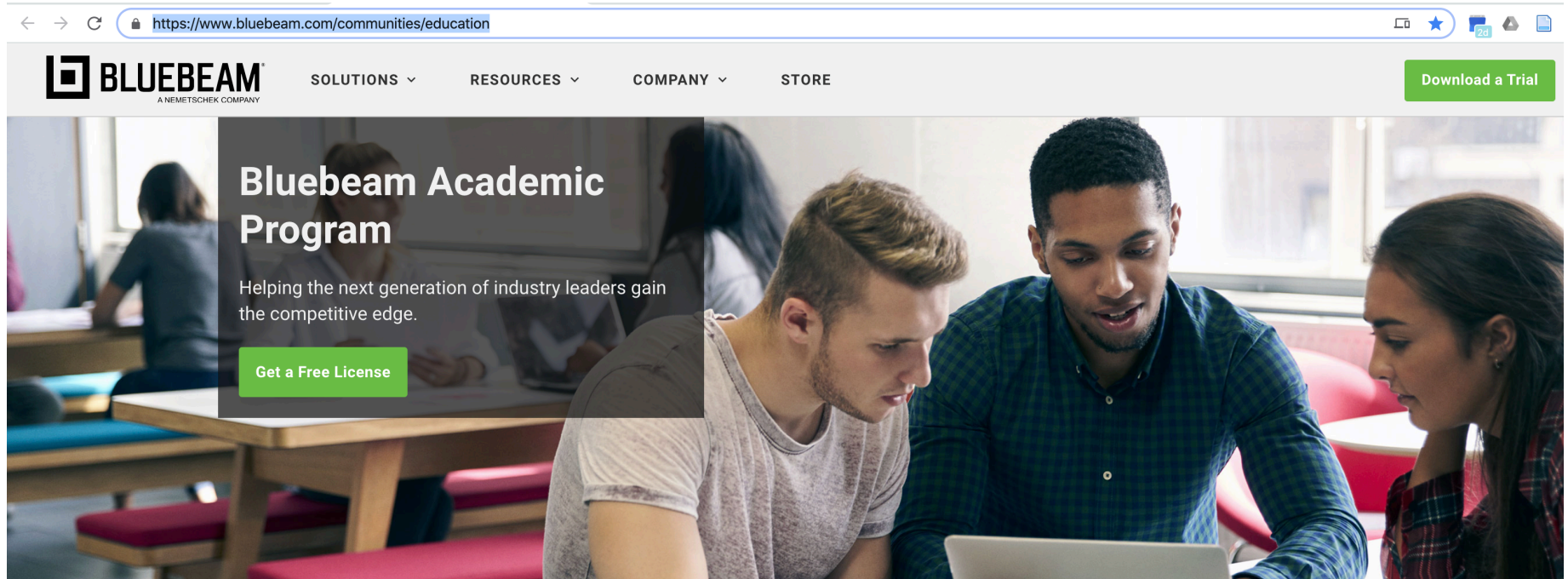
CLASS ACTIVITY

Class Activity

- Form six groups
- Spend 15 – 30 minutes to review the drawings
- Summarize your findings:
 - Formatting and layout
 - Brief overview of the equipment and systems
 - Details

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