

# Facility Dynamics

## *ENGINEERING*

## Application Requirements

### The System Concept

**Presented By:**

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Senior Engineer

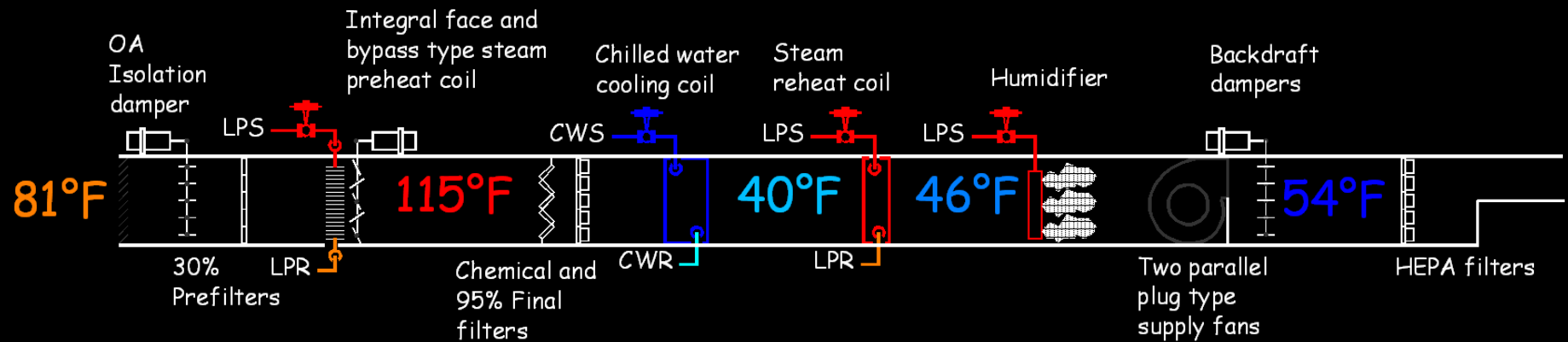
NAVFAC, San Diego

# Resource for Details Behind this Content

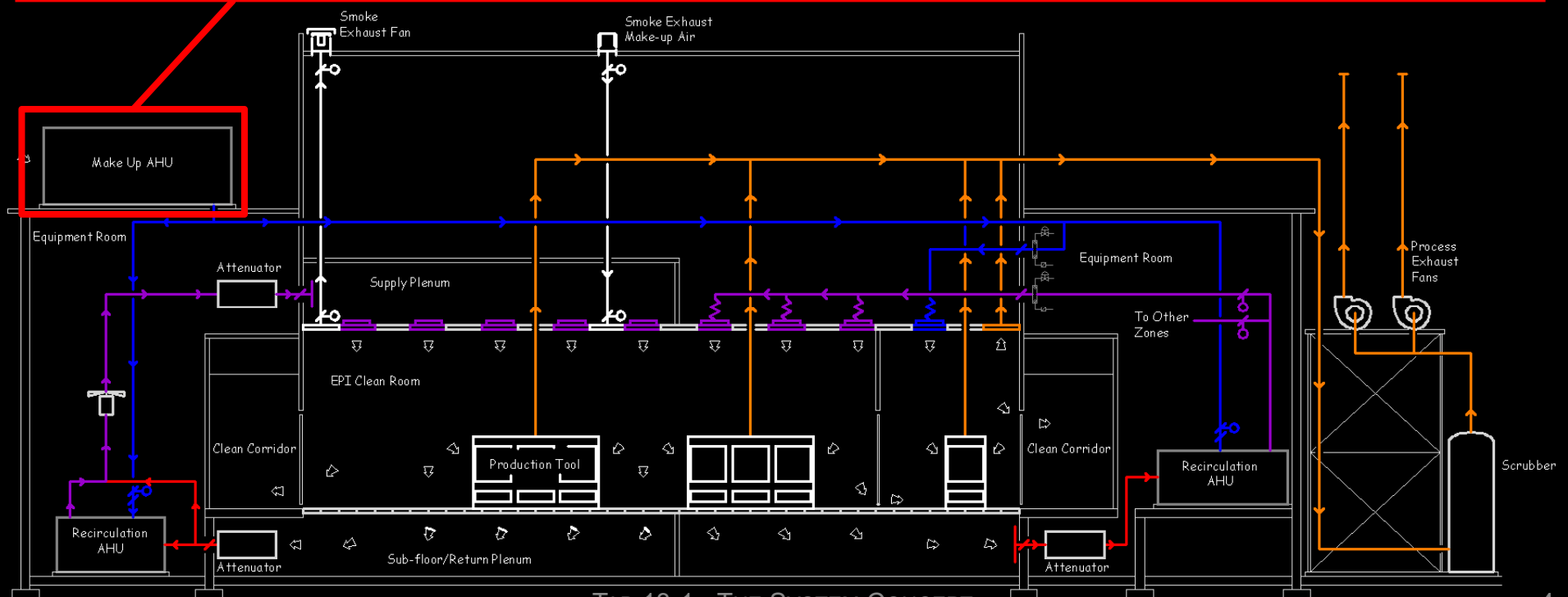
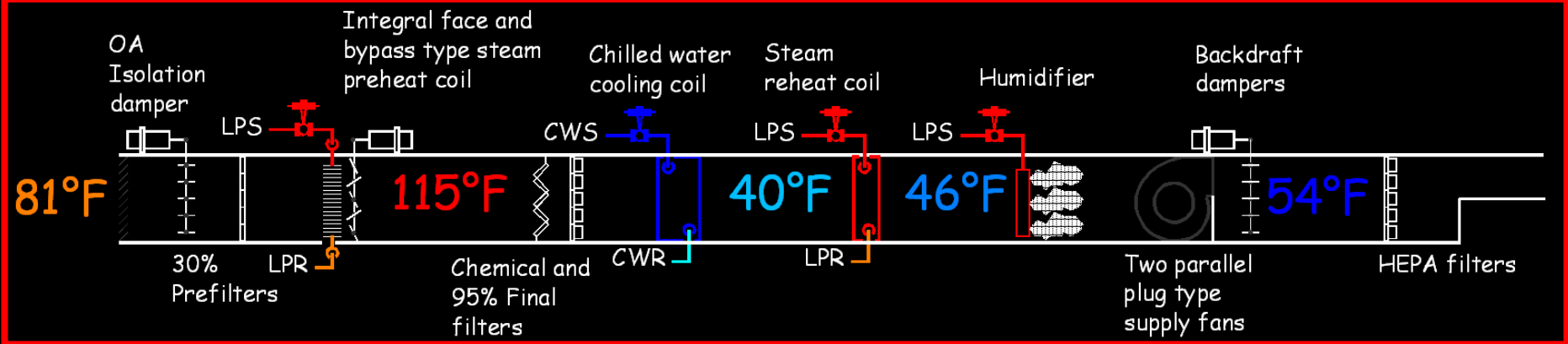
[www.Av8rdas.Wordpress.com](http://www.Av8rdas.Wordpress.com)

Posts with the heading “System Diagrams: ...”

# Its Not Just an Air Handling Unit ...

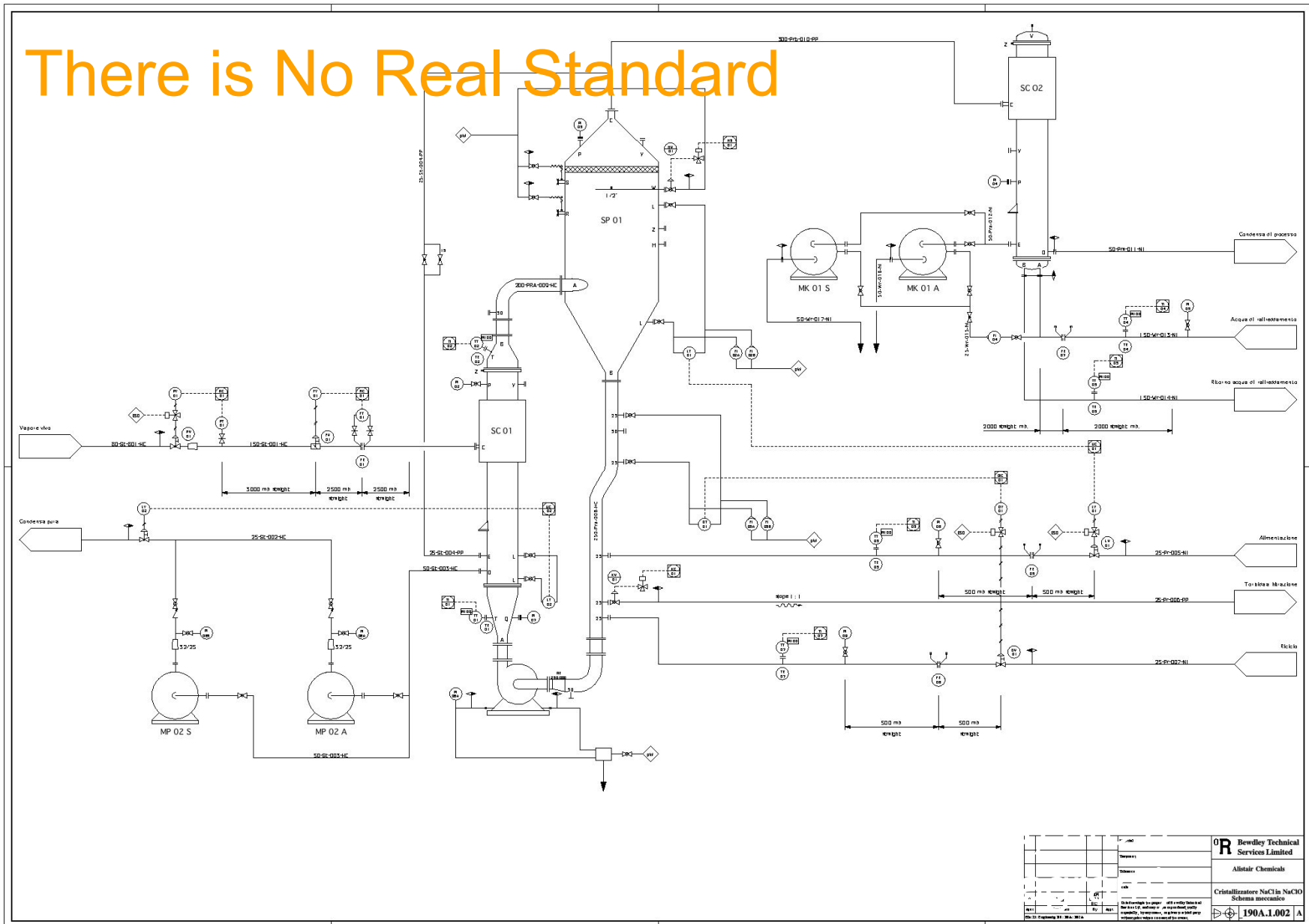


# Its Not Just an Air Handling Unit ... ...It's an Air Handling System



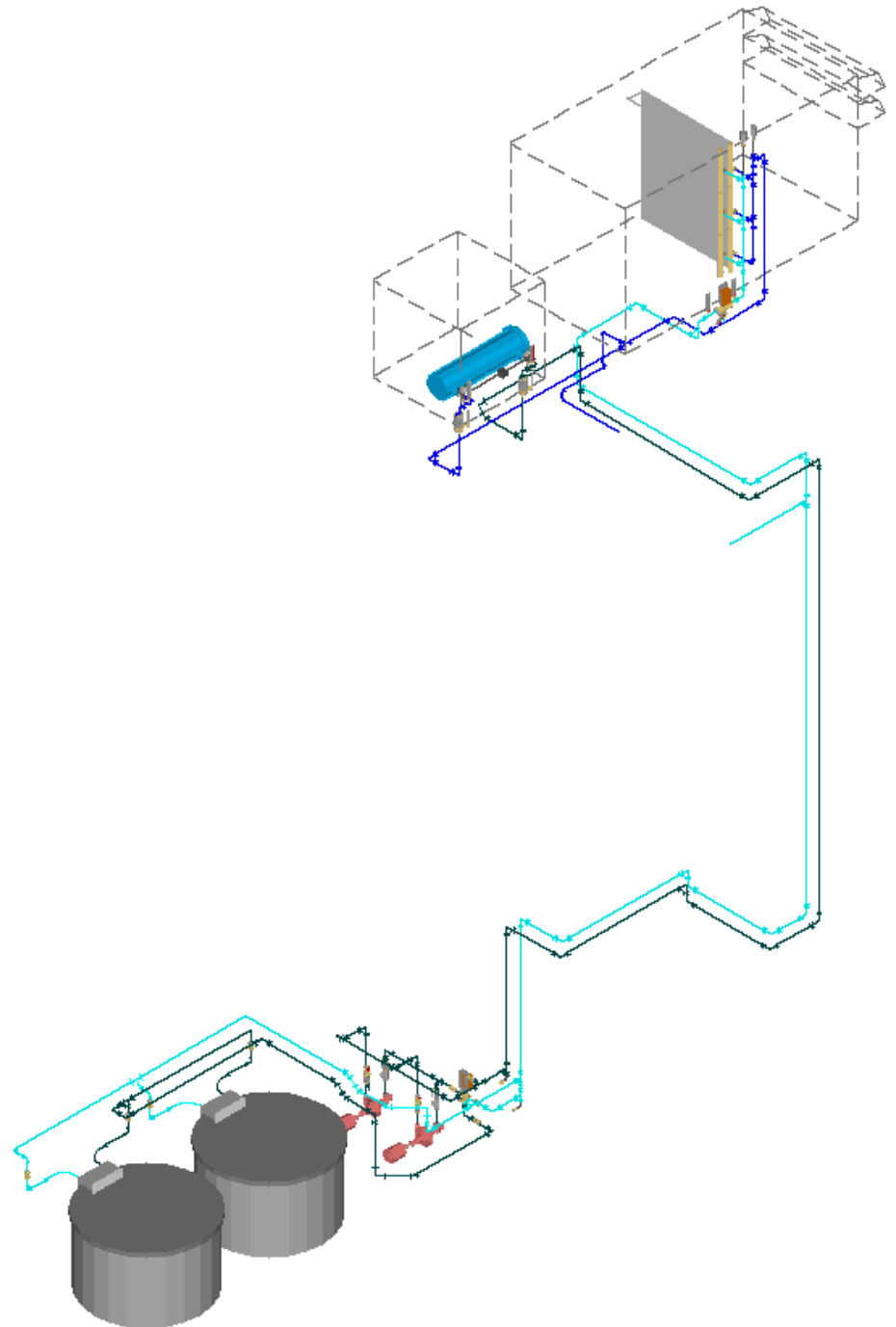
TAB 13-1 - THE SYSTEM CONCEPT

# There is No Real Standard



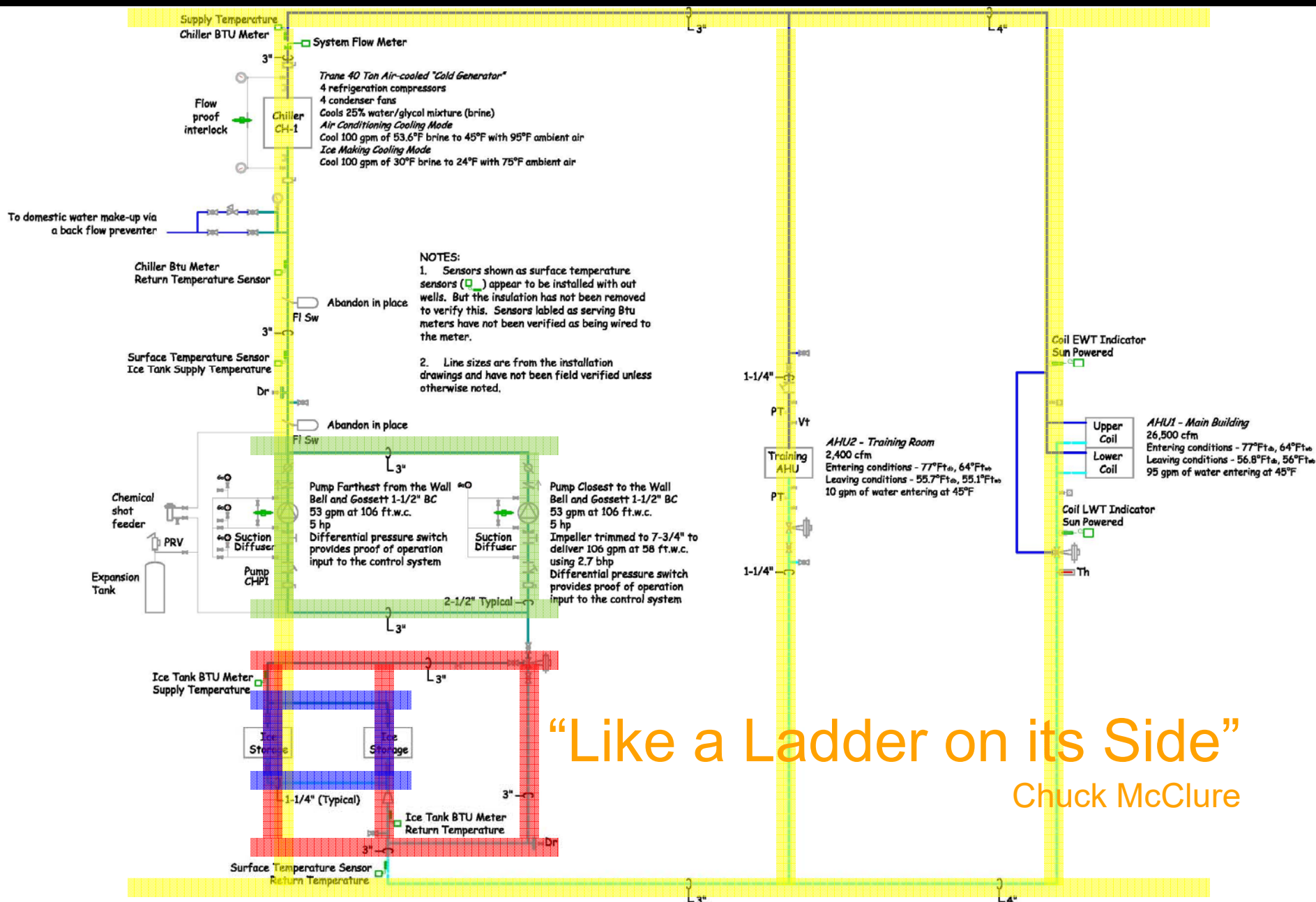
[http://en.wikipedia.org/wiki/Piping\\_and\\_instrumentation\\_diagram](http://en.wikipedia.org/wiki/Piping_and_instrumentation_diagram) - From the author's own work - Creative Commons Share Alike

Physically Complex,



TAB 13-1 - THE SYSTEM CONCEPT





“Like a Ladder on its Side”

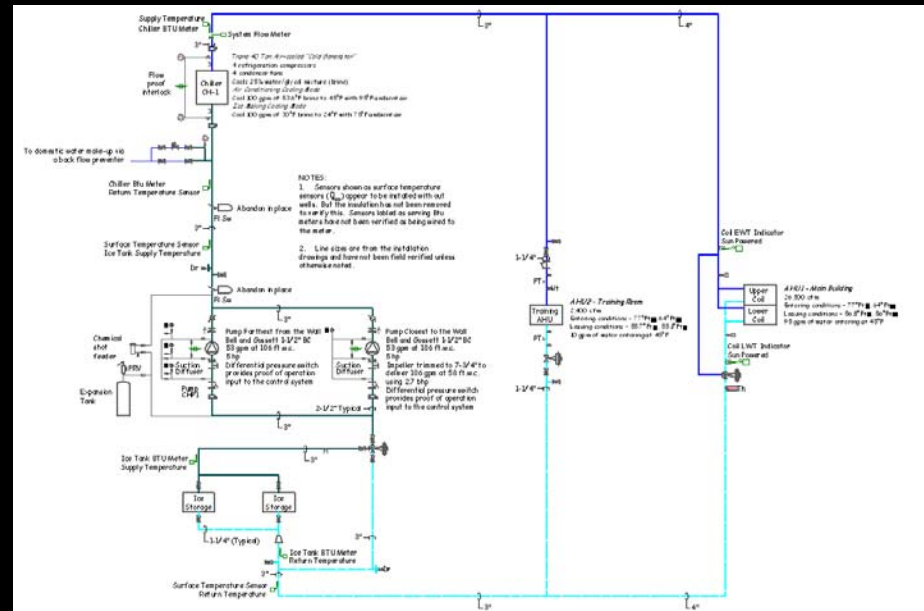
Chuck McClure



## Order of Connection Matters

## “What’s using up the pump head?” focus

# “What’s making and using cold glycol?” focus



10

# “Untangled” versus “Tangled”



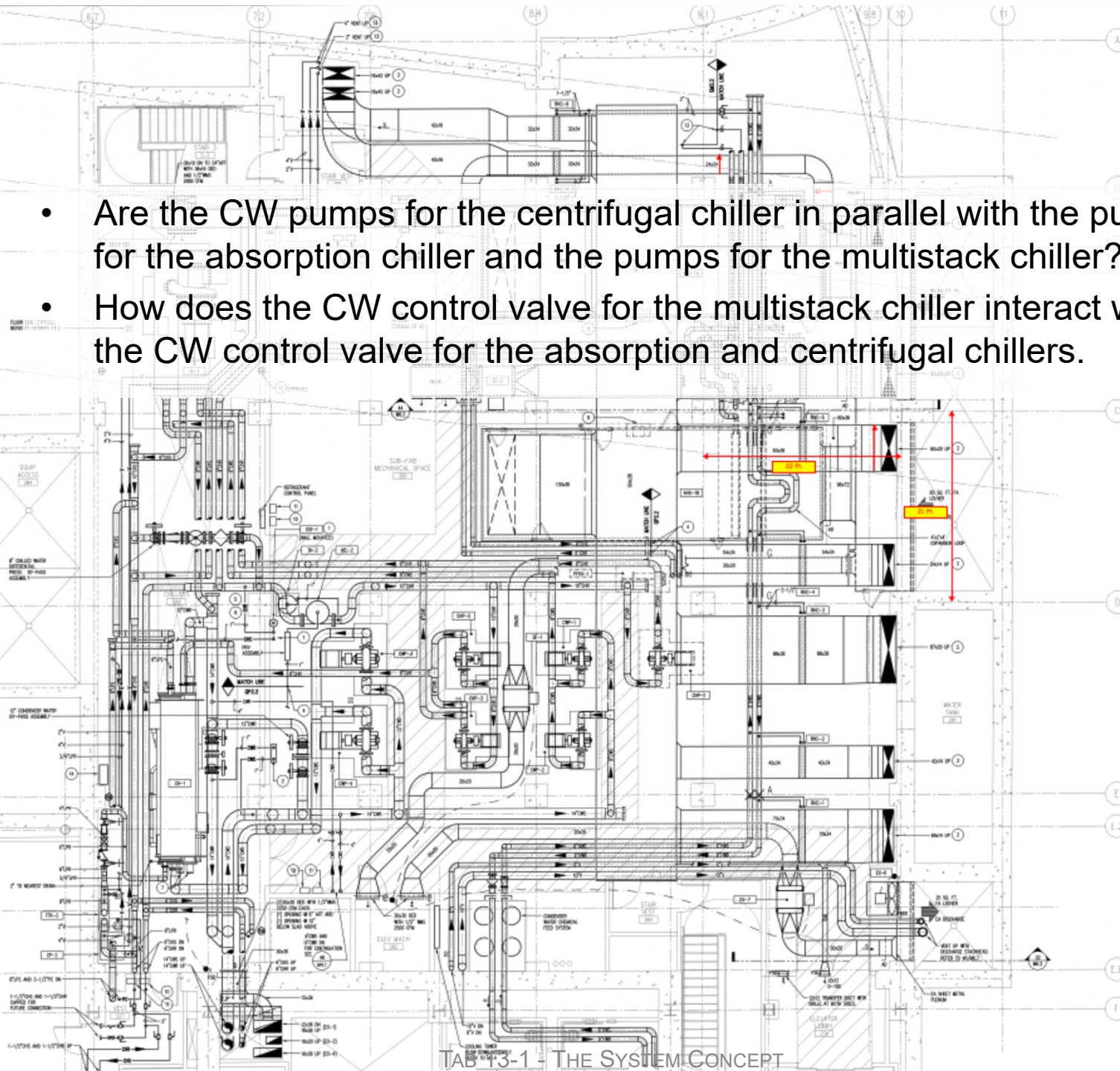
tangled *adj*

1. existing in or giving the appearance of a state of utter disorder
2. very involved : exceedingly complex

# Tangled



- Are the CW pumps for the centrifugal chiller in parallel with the pumps for the absorption chiller and the pumps for the multistack chiller?
- How does the CW control valve for the multistack chiller interact with the CW control valve for the absorption and centrifugal chillers.



# SHEET NOTES

1. REFER TO DRAWING SET FOR ADDITIONAL SHEET NOTES.
2. ALL PIPING SHALL BE 30 INCHES IN DIAMETER UNLESS OTHERWISE NOTED. ALL PIPING SHALL BE 30 INCHES IN DIAMETER UNLESS OTHERWISE NOTED.
3. PIPING ABOVE 4 INCHES IN DIAMETER AND DEEPER THAN 4 INCHES IN DIAMETER SHALL BE SUPPORTED BY EQUIVALENT STRUCTURAL CONSTRUCTION LOCATED IN THE SUB-FIND MECHANICAL ROOM AND THE CHILLER ROOM. PIPING SHALL NOT BE SUPPORTED FROM SLAB, IN SLAB PENETRATION SUPPORT FOR STRUCTURAL AND PIPING FROM A REINFORCED CONCRETE SLAB SHALL BE LOCATED BELOW IN SLAB.
4. PIPING CONTRACTOR SHALL PROVIDE EQUIPMENT, SIZES, AND PIPING SCHEDULES, BRANCHES AND WORKMAN FOR SPECIFICATION SECTION 2804.

## KEYED NOTES

1. MECHANICAL SHUT OFFER.
2. 12" COLD WATER SUPPLY AND RETURN SHALL BE WALL MOUNTED CIRCULAR COPPER ALUMINUM.
3. CONNECT TO MECHANICAL ROOM, REFER TO DRAWING SET.
4. CONNECT TO MECHANICAL ROOM, REFER TO DRAWING SET.
5. CHILLER ROOM CONSTRUCTION SHALL BE 400-100-10.
6. NO PIPING, VALVES, CONNECTIONS, TRAYS, ETC. PERMITTED TO BE LOCATED WITHIN 10' OF THE CHILLER ROOM.
7. MANUFACTURER INSTALLED CROSSFLOW CONDENSER WATER PIPING.
8. HEATING AND COOLING COIL SHALL BE 100-100-10.
9. SUPPLY FOR VES REFER TO DRAWING SET.
10. EMERGENCY REGULATION CONTROL SWITCH (BREAKING GLASS TYPE) FOR ADDITIONAL INFORMATION REFER TO SPECIFICATION SECTION 2804-10-10.
11. EMERGENCY PUMP REGULATION CONTROL SWITCH (BREAKING GLASS TYPE) FOR ADDITIONAL INFORMATION REFER TO SPECIFICATION SECTION 2804-10-10.
12. CHILLER PLANT REGULATION LEAK MONITOR PROVIDED BY CHILLER MANUFACTURER FOR REGULATION OF CHILLER. IT PROVIDES A WARNING OF FOUR LEAK MONITOR SIGNALS REQUIRED FOR THE MANUFACTURER'S REGULATION INSTRUCTIONS. MONITOR SIGNALS TO SAMPLE THE NORMAL FOR REVIEW AND REMEDIAL ACTION TO THE INSTALLATION. THE SIGNALS SHALL INCLUDE BUT NOT BE LIMITED TO: HIGH-UP, LOW-UP, LOW-DOWN, AND LOW-DOWN.
13. CONNECT TO MECHANICAL ROOM, REFER TO DRAWING SET.
14. CONDENSATE FLOW METER.

TAB 13-1 - THE SYSTEM CONCEPT

# SHEET NOTES

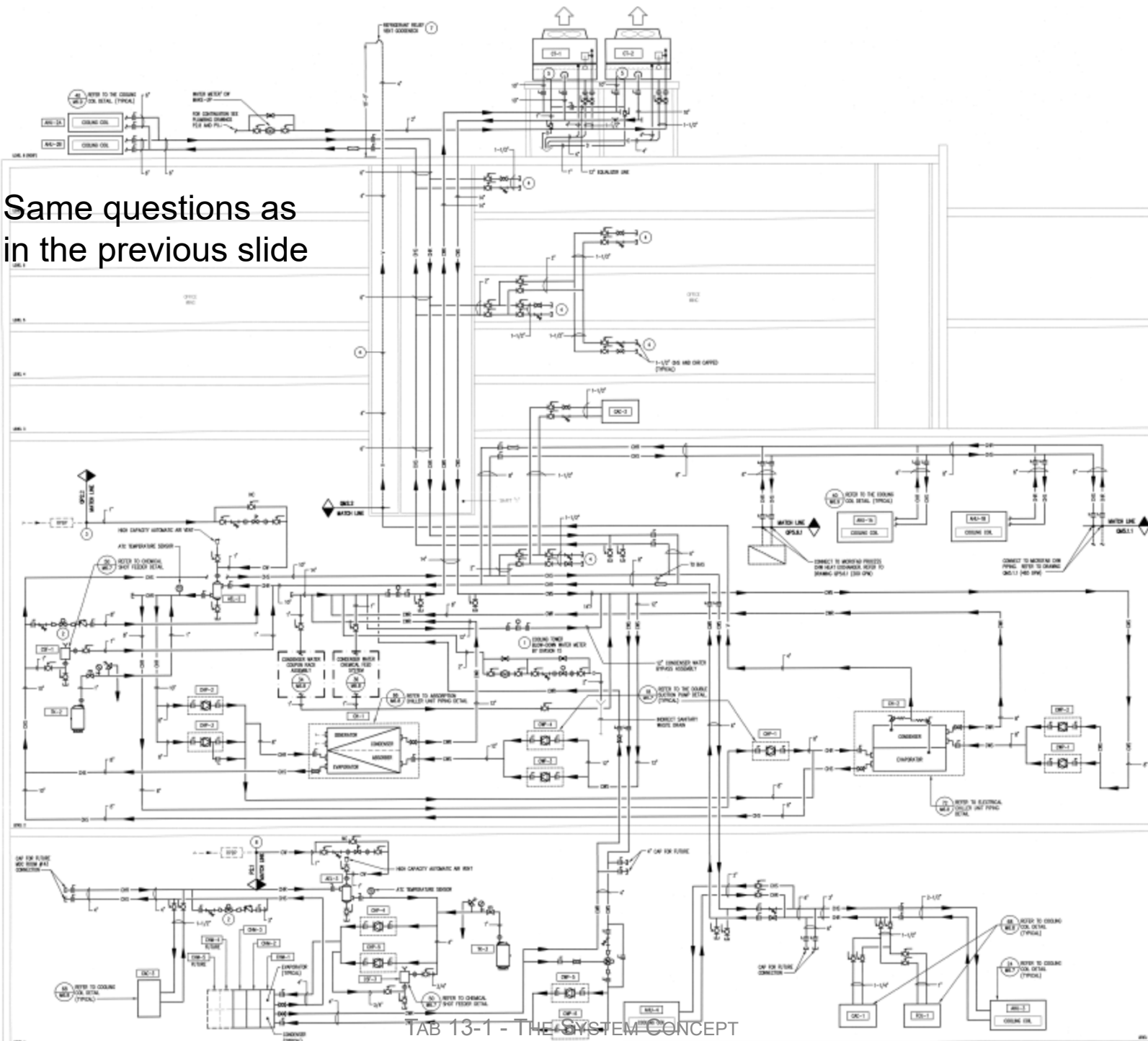
1. REFER TO DRAWING SET FOR ADDITIONAL SHEET NOTES.
2. UNLESS OTHERWISE NOTED, ALL HWY AND VHW CONNECTIONS TO HEAVY HEATING COILS SHALL BE 1".
3. PIPING ABOVE 4 INCHES IN DIAMETER AND DUCTS ABOVE 30 INCHES IN DIAMETER SHALL BE EQUIPPED WITH ANTI-VIBRATION MEASURES LOCATED IN THE SUB-FLOOR MECHANICAL ROOM AND THE CHILLER ROOM. SUCH MEASURES SHALL BE SUPPORTED FROM LEVEL, IN SLAB, THROUGH SUPPORTS FOR STRUCTURAL AND PIPING FROM A REINFORCED CONCRETE SLAB WITH JOINTS BELOW IN SLAB.
4. HVAC CONTRACTOR SHALL PROVIDE EQUIPMENT, DUCT, AND PIPING SCHEMATIC DRAWING AND INFORMATION FOR SPECIFICATION SECTION 3040.

## KEYED NOTES

1. CHILLER SHUT DOWN.
2. 1" COLD WATER SUPPLY AND RETURN FROM TO WALL MOUNTED CONDENSER COILS. ASSEMBLY.
3. CONNECT TO MECHANICAL ROOM. REFER TO DRAWING SET.
4. CONNECT TO MECHANICAL ROOM. REFER TO DRAWING SET.
5. CHILLER ROOM CONSTRUCTION SHALL BE AS FOLLOWS:  
NO PERFORATED DUCTS, TRAYS, ETC. PERMITTED TO THE CHILLER ROOM SHALL PASS THROUGH THE CHILLER ROOM.
6. MANUFACTURER INSTALLED CROSSFLOW CONDENSER WATER PIPING.
7. HEATING AND COOLING COIL SHALL BE 1" DIA.
8. SUPPLY FOR VEH. REFER TO DRAWING SET.
9. EMERGENCY REGENERATION CONTROL SWITCH (BREAKING GLASS TYPE) FOR ADDITIONAL INFORMATION REFER TO SPECIFICATION SECTION 3000-01-01.
10. EMERGENCY FLOOD REGENERATION CONTROL SWITCH (BREAKING GLASS TYPE) FOR ADDITIONAL INFORMATION REFER TO SPECIFICATION SECTION 3000-01-01.
11. CHILLER PLANT REGENERATION CONTROL SWITCH (BREAKING GLASS TYPE) FOR ADDITIONAL INFORMATION REFER TO SPECIFICATION SECTION 3000-01-01.
12. CHILLER PLANT REGENERATION CONTROL SWITCH (BREAKING GLASS TYPE) FOR ADDITIONAL INFORMATION REFER TO SPECIFICATION SECTION 3000-01-01.
13. CONNECT TO MECHANICAL ROOM. REFER TO DRAWING SET.
14. CONDENSATE FLOW METER.

TAB 13-1 - THE SYSTEM CONCEPT

Same questions as  
in the previous slide

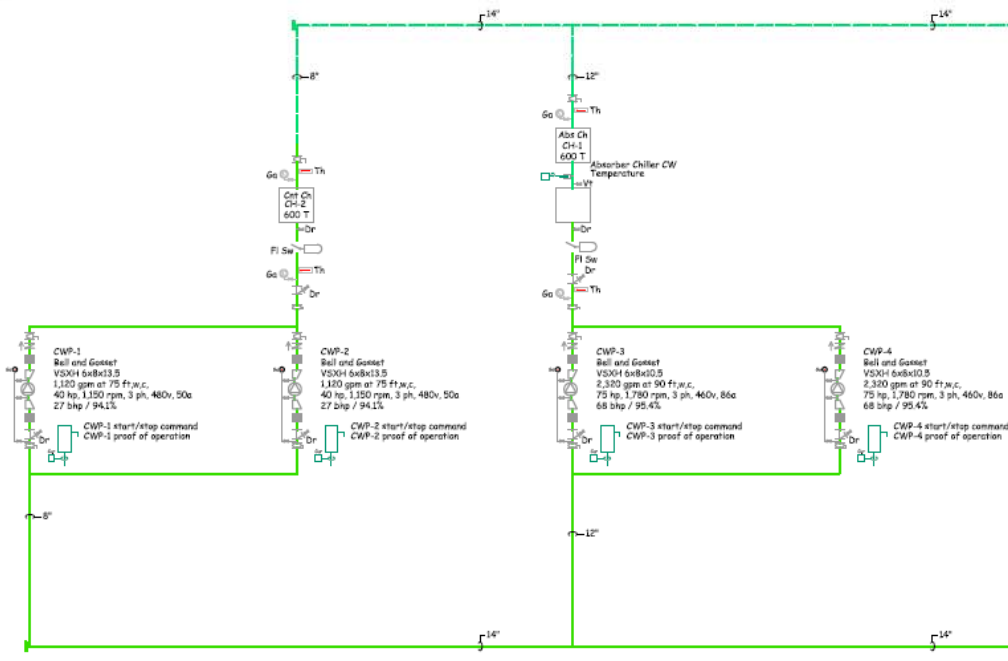
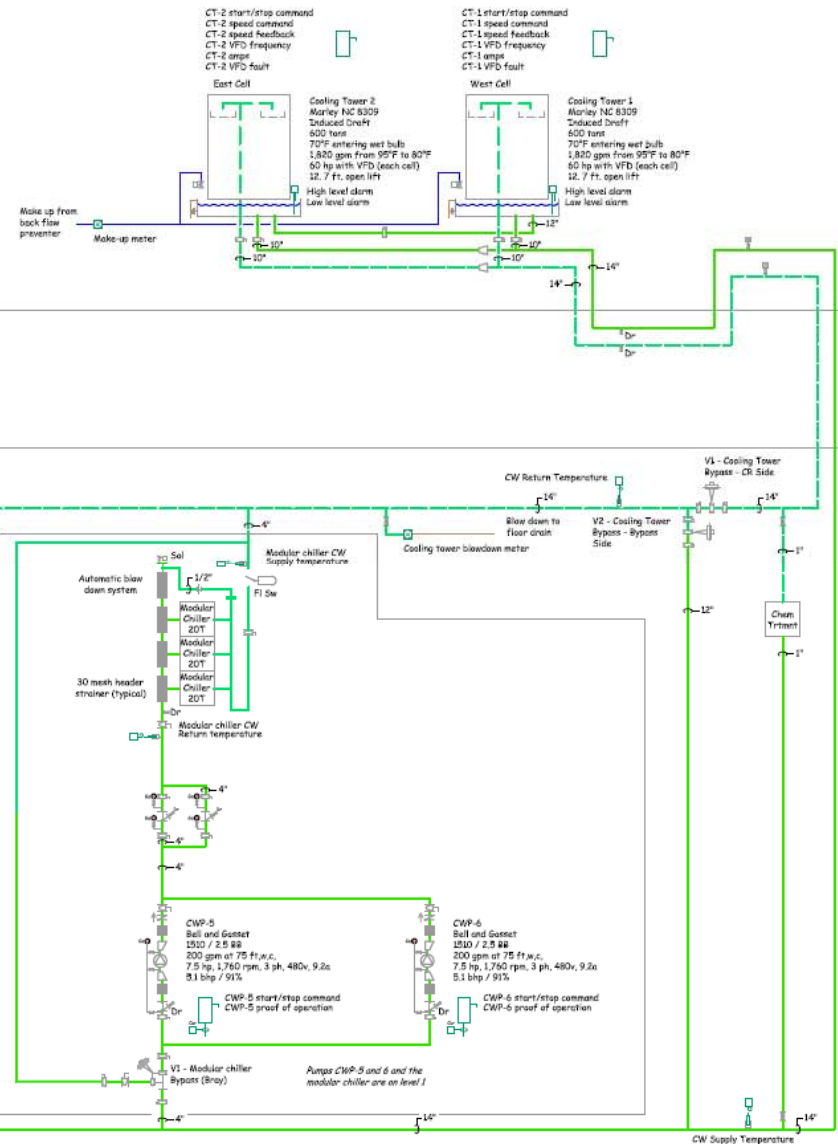


TAB 13-1 - THE SYSTEM CONCEPT

Same questions as  
in the previous slide

Roof Level

Level 2l



TAB 13-1 - THE SYSTEM CONCEPT

# “Untangled” versus “Tangled”

Keep simplifying things to minimize line crossings and head towards a “ladder on its side”

But remember:

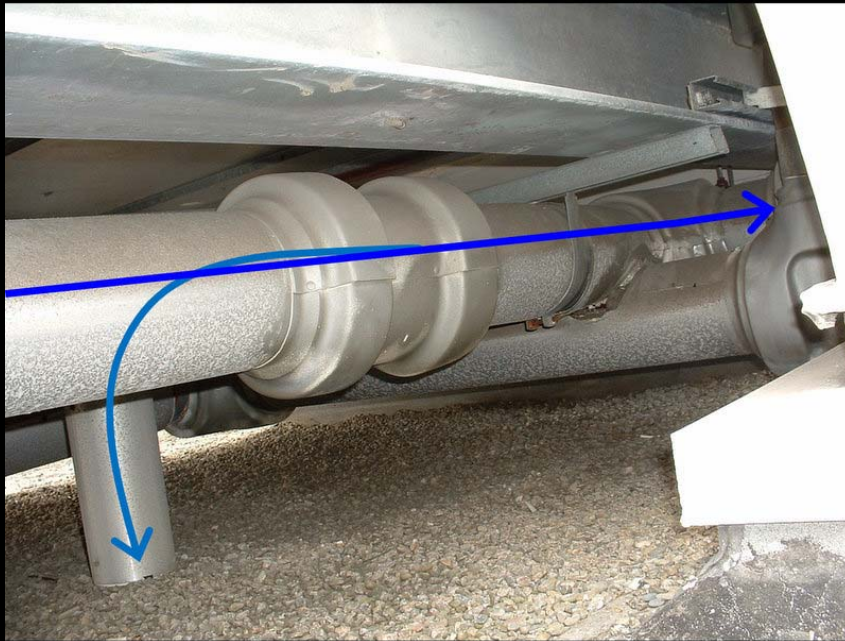
*Things should be made as simple as possible, but not any simpler.*

*Albert Einstein*

That means for a system diagram, order of connection “trumps” untangled

# What About Fittings?

Tees Are Important



Elbows; Maybe Not so Much



# System Diagram Rules for Elbows and Tees

Show all tees

- Verify order of connection
- Order of connection “trumps” drawing organization
- Drawing organization “trumps” matching branch and main configuration in the field

Don't show elbows

- Turns on the system diagram should be made for drawing organization purposes, not to reflect real elbows

# Sometimes Rules are Made to be Broken

Elbows that form traps or inverted traps in open systems

Pipes that run above basin level in open systems

Pipe runs with an relatively excessive number of elbows

Tees where the pressure drop created by the installed configuration could cause an operational issue



So Far, Our Focus Has Been Hydronic Systems; What About Air Systems?



Can You Identify the HVAC/Air Handling System Elements in this Picture?

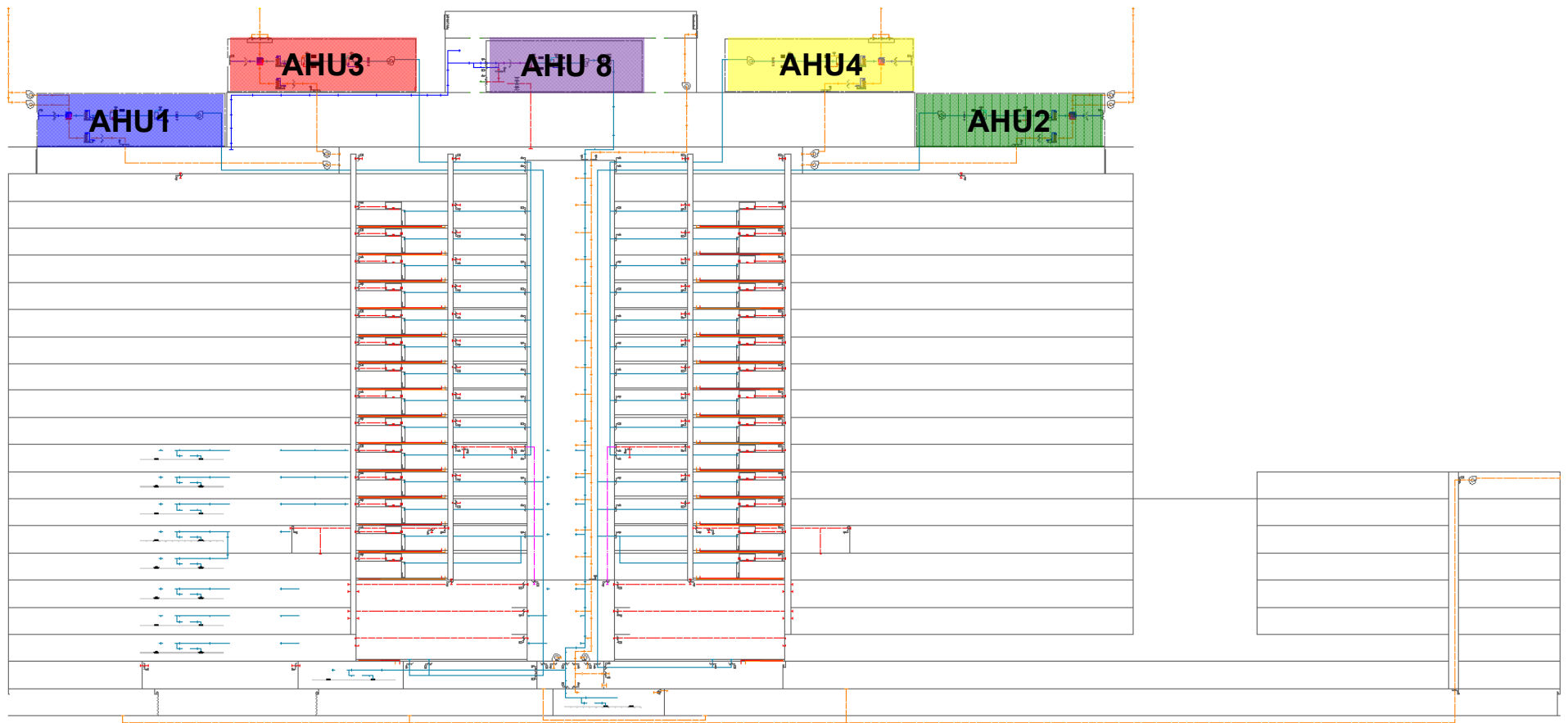
# Air Handling Systems and System Diagrams

The same general rules apply

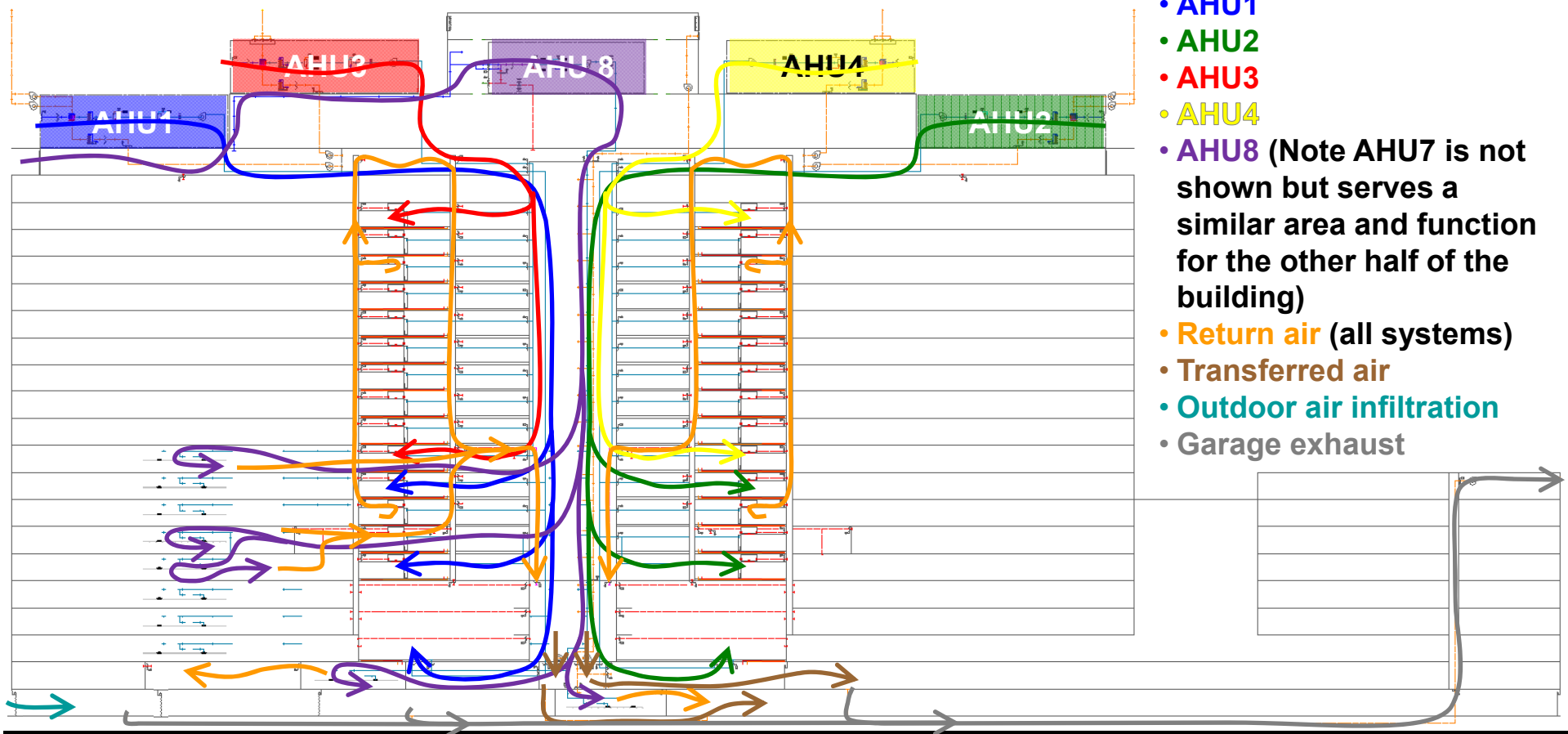
Significant differences from piping systems

- Envelope is a part of the system
- Mass (air and water vapor) are actively moved across the system boundary by the operation of the system
- The water vapor can change state in the system
- People move around inside the systems
- Building processes occur inside the system

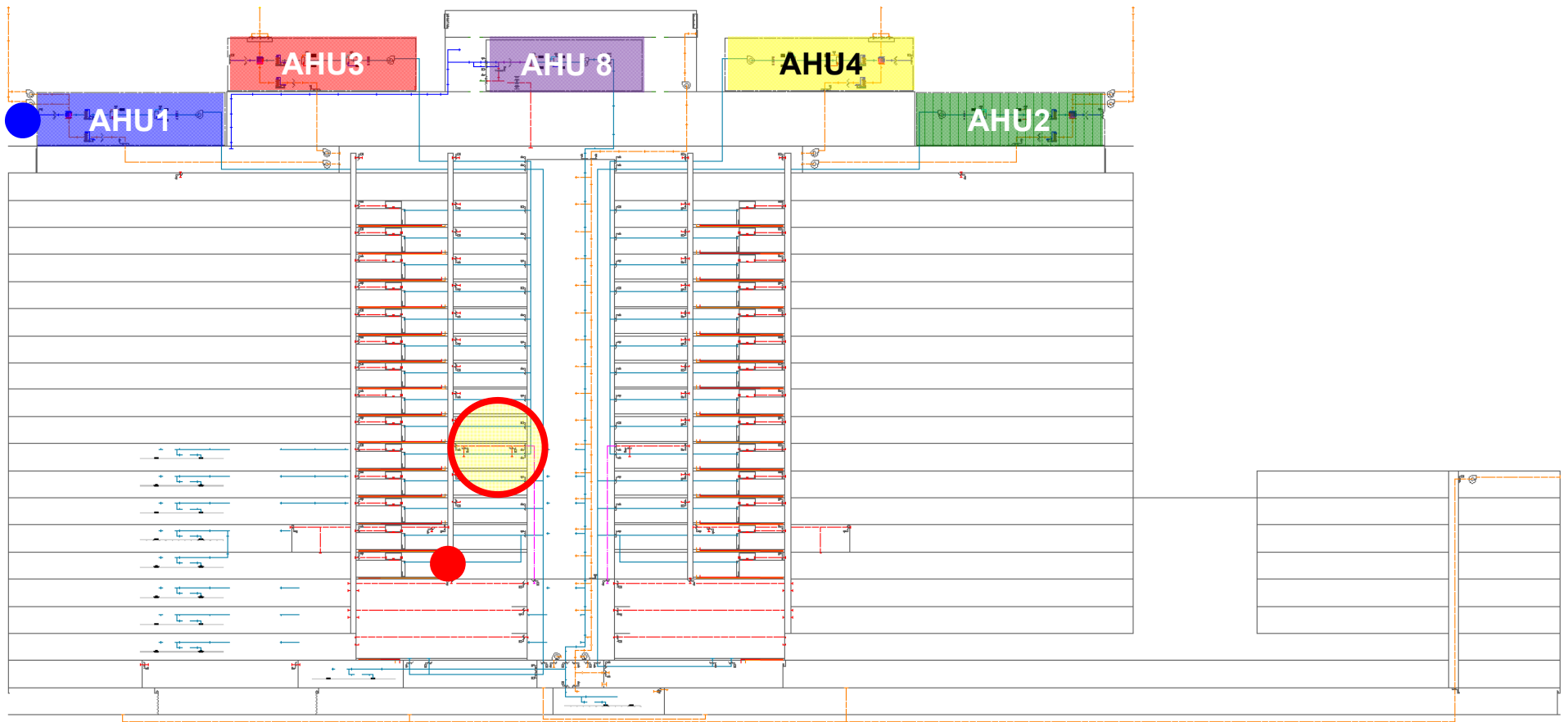
# The Envelope as the Framework for the Air Handling System Diagram



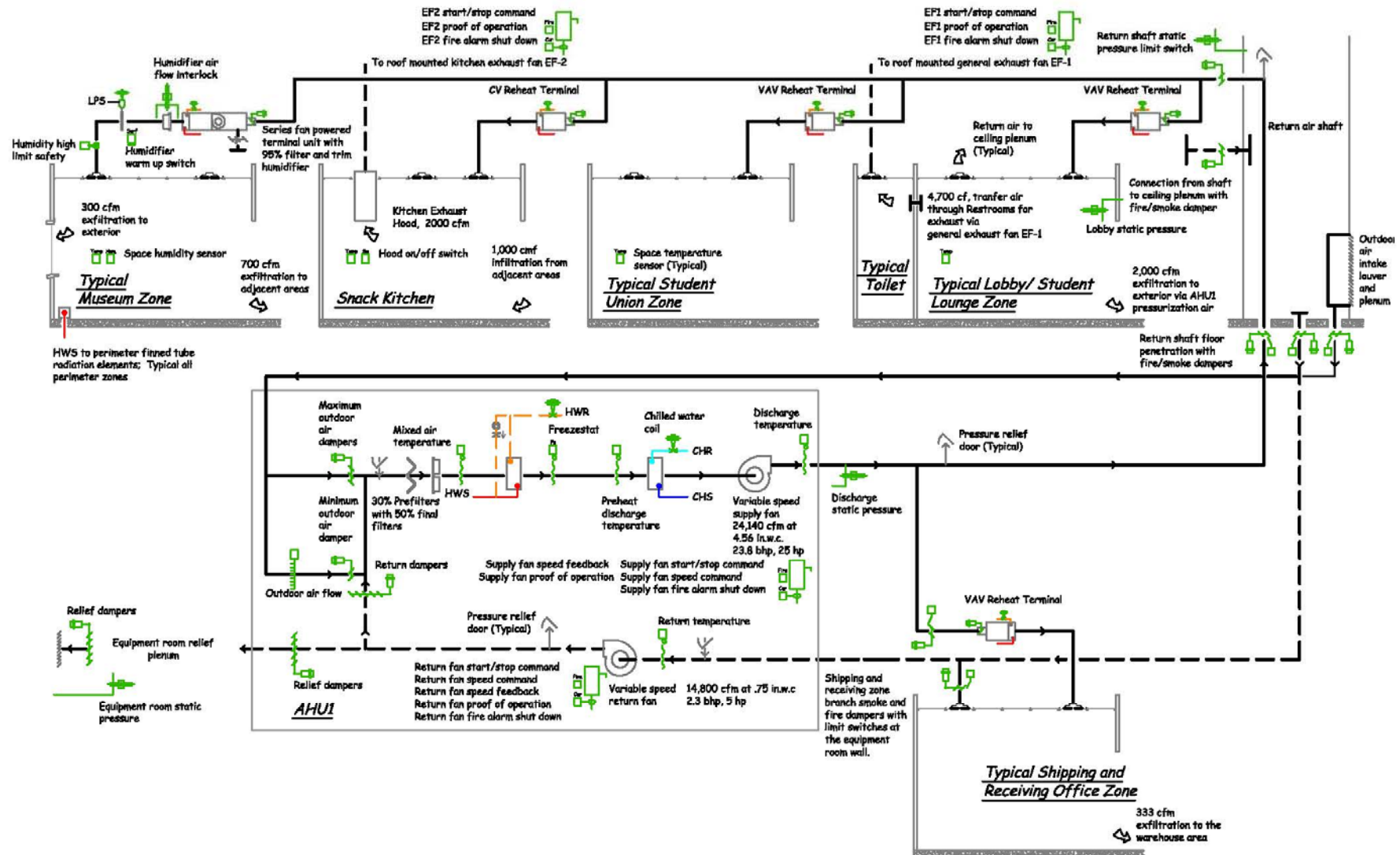
# The Envelope as the Framework for the Air Handling System Diagnostics



# The Envelope as the Framework for the Air Handling System Diagnostics

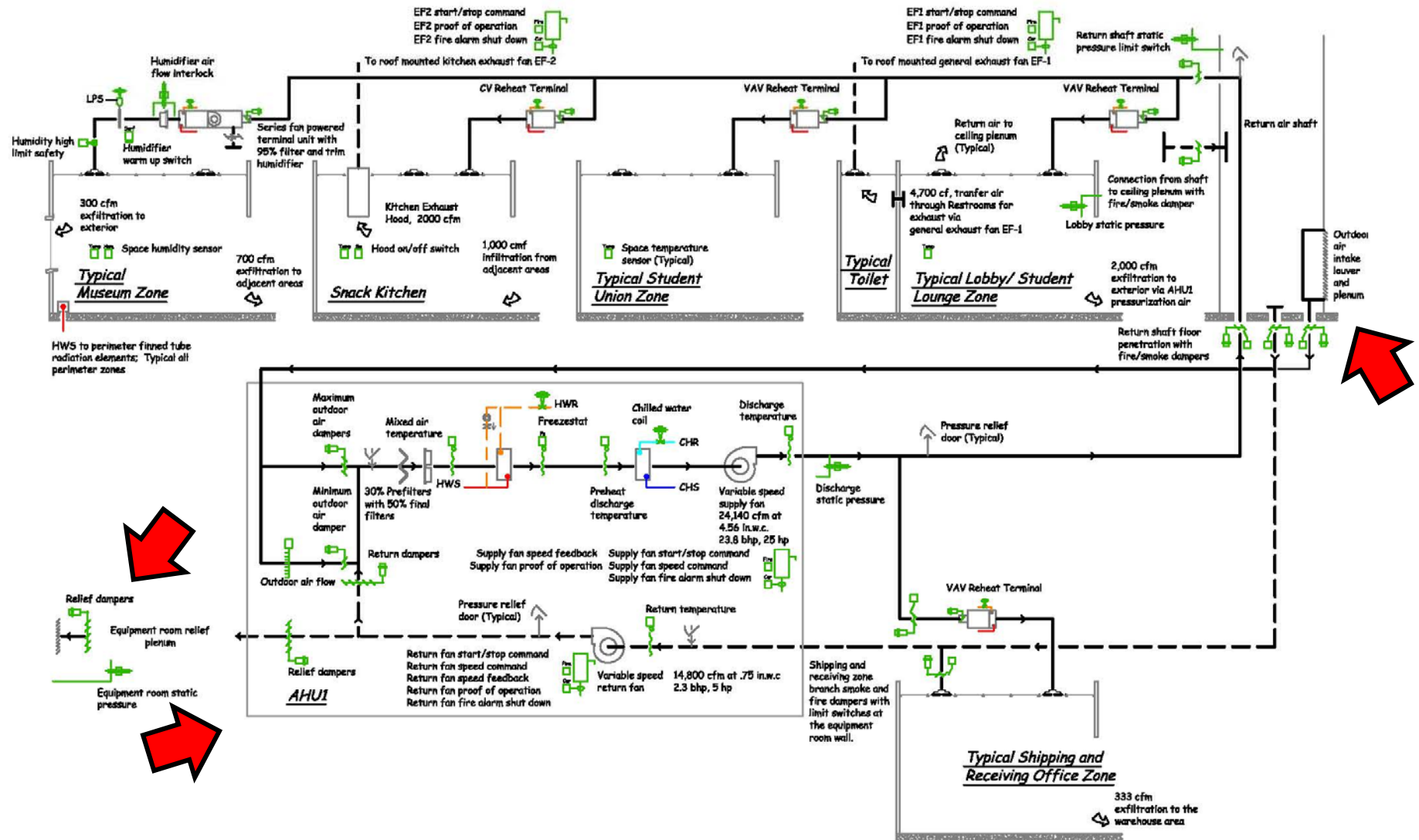


# Air Handling System Diagram Characteristics



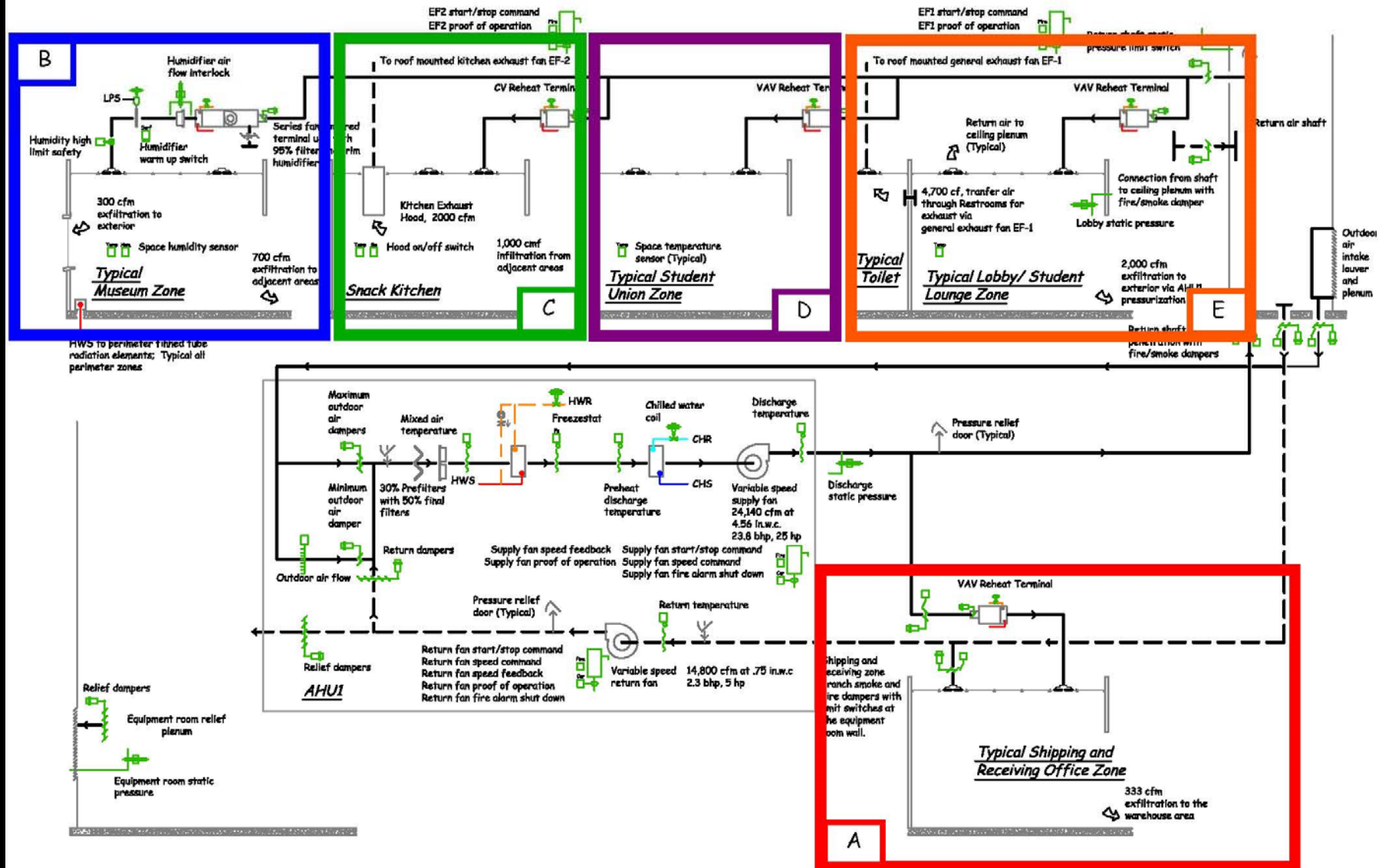
TAB 13-1 - THE SYSTEM CONCEPT

# Reflect the Building Physical Arrangement



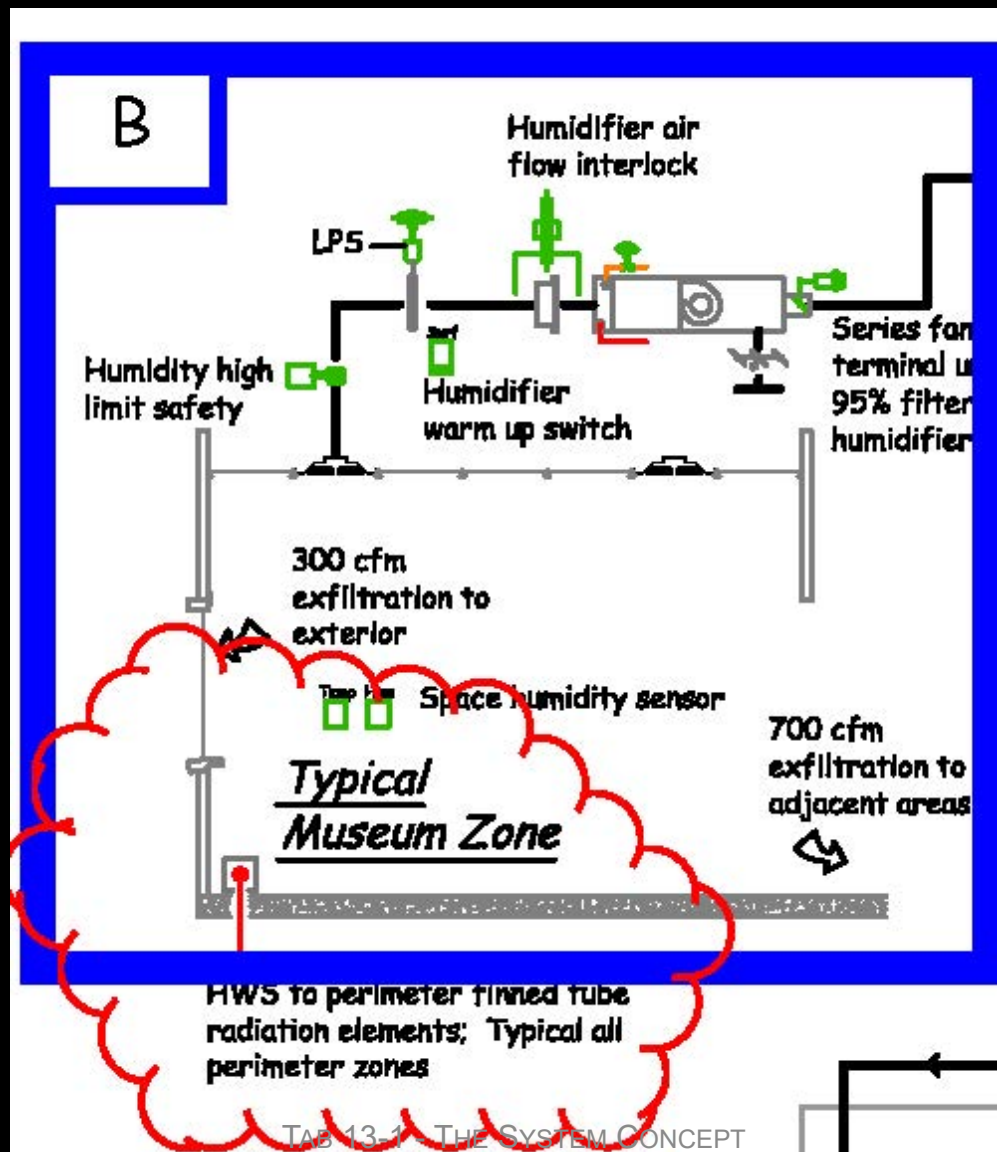
TAB 13-1 - THE SYSTEM CONCEPT

# Include Examples of Each Zone Type

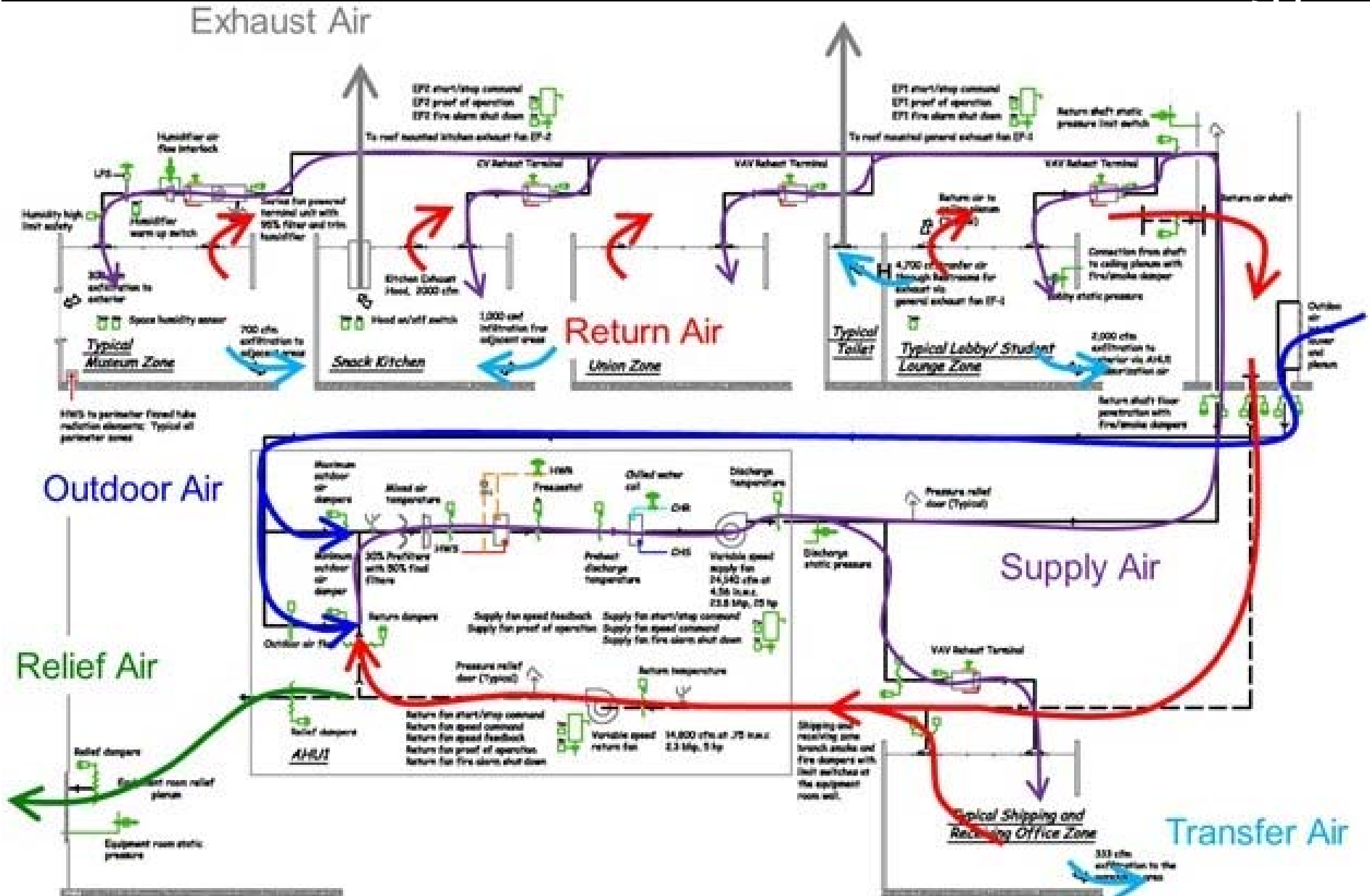


TAB 13-1 - THE SYSTEM CONCEPT

# Include the Impacts of Other Systems



# Document Conservation of Mass and Energy



TAB 13-1 - THE SYSTEM CONCEPT